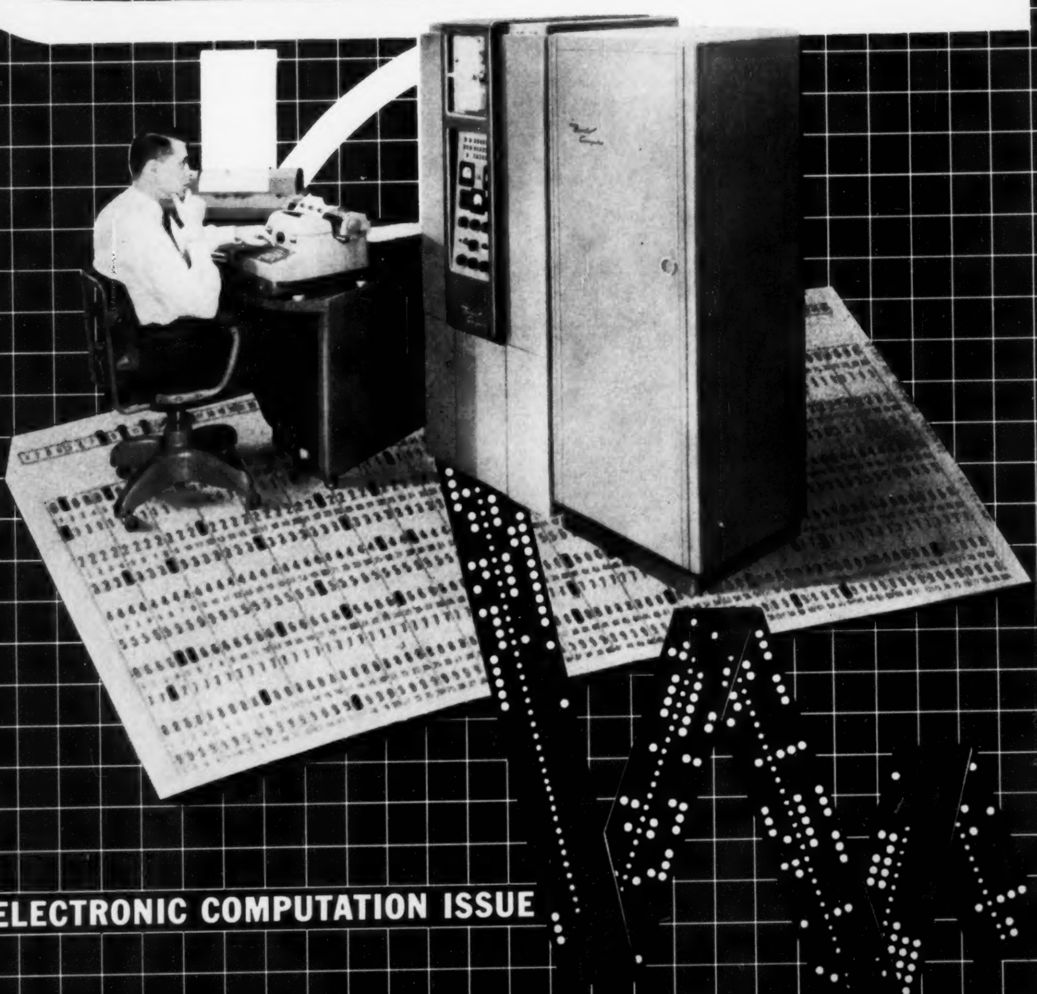
CIVIL ENGINEERING



AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

ELECTRONIC COMPUTATION ISSUE

PROGRAM • PORTLAND CONVENTION • JUNE 23-27

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95 PAYHAULER® FLEET

speeds load-delivery 50%

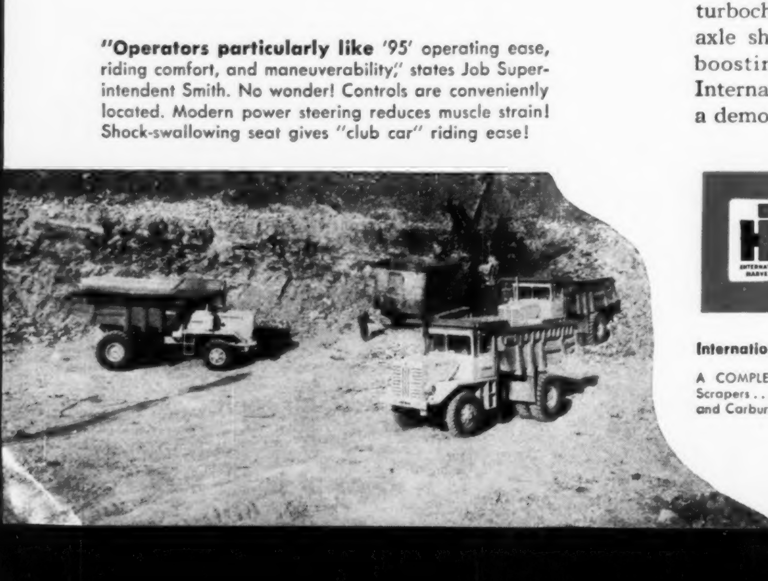
...for Central Pa. Quarry, Stripping, and Construction Co., Hazelton, Pa.

Relocating 1.9 miles of U.S. 40, east of Flintstone, Maryland, Central Pennsylvania Quarry, Stripping, and Construction Co. is moving 1,200,000 cu. yd.—90% of it rock—with five International 95 Payhaulers!

The terrain requires the deepest cut (146 feet), and highest fill (150 feet), in Maryland. The haul is 4,000 feet, with dangerous downgrades exceeding 25%.

Their Payhauler fleet is operating beside competitive haulers down the same steep haul-road. This permits accurate ton-for-ton, and penny-for-penny performance comparisons.

"Operators particularly like '95' operating ease, riding comfort, and maneuverability," states Job Superintendent Smith. No wonder! Controls are conveniently located. Modern power steering reduces muscle strain! Shock-swallowing seat gives "club car" riding ease!



Here's what Job Supt. Harry G. Smith reports:

"Delivery time halved"

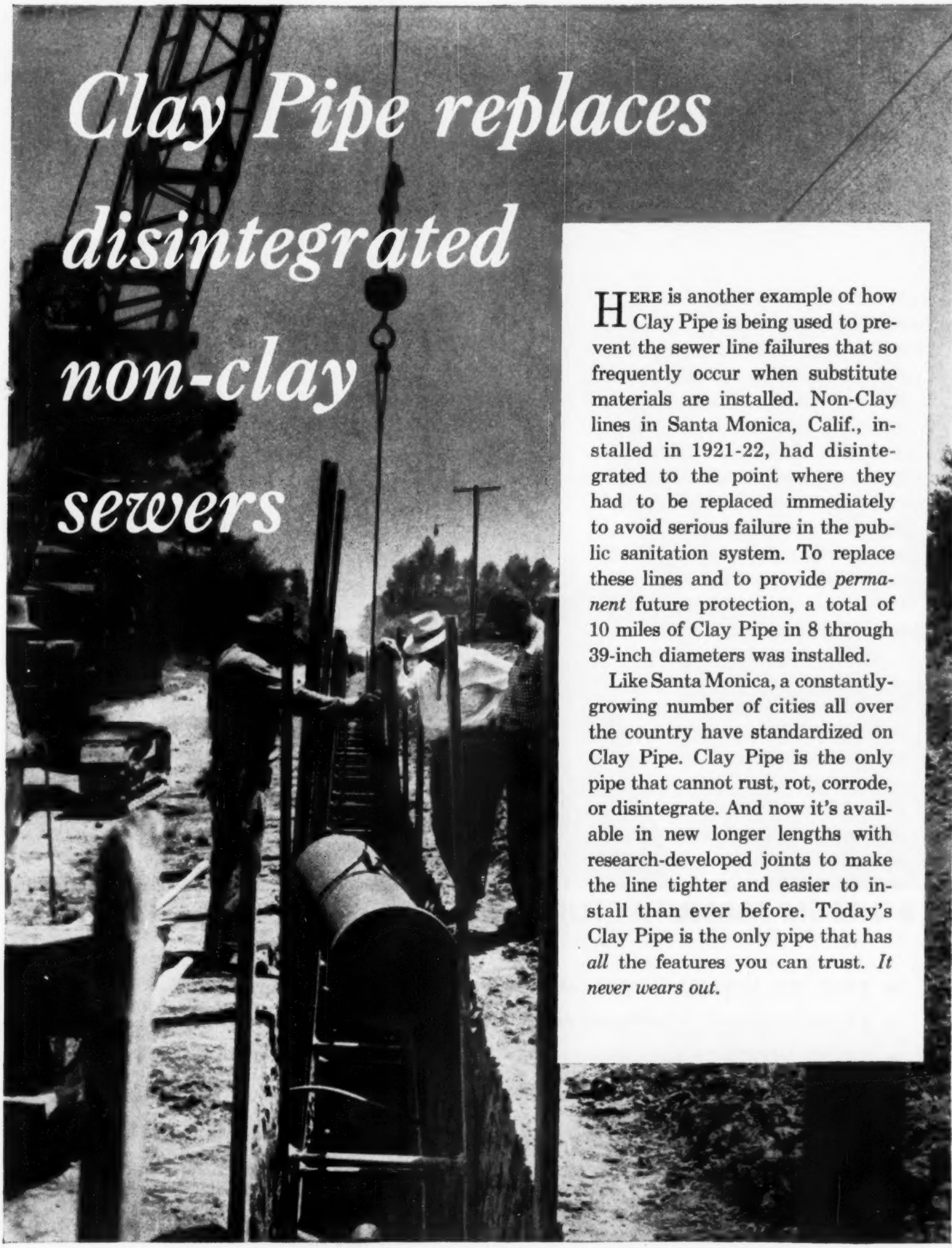
"The '95's' have cut costs of hauling large payloads because Torqmatic braking has cut delivery time in half over the other machines." A fully-loaded Payhauler can go down the steep grades much faster than a conventionally-braked hauler. With complete safety, too!

See how Torqmatic braking gives positive load control at any practical speed—on any grade. Try "95" get-away and climb-out speed, with the wallop of 335 turbocharged diesel "horses." Measure planetary drive axle shock-absorbing advantages. Prove production-boosting Payhauler operating ease. See your International Construction Equipment Distributor for a demonstration!

International® Construction Equipment

International Harvester Co., 180 N. Michigan Avenue, Chicago 1, Illinois

A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors... Self-Propelled Scrapers... Crawler and Rubber-Tired Loaders... Off-Highway Haulers... Diesel and Carbureted Engines... Motor Trucks... Farm Tractors and Equipment.



HERE is another example of how Clay Pipe is being used to prevent the sewer line failures that so frequently occur when substitute materials are installed. Non-Clay lines in Santa Monica, Calif., installed in 1921-22, had disintegrated to the point where they had to be replaced immediately to avoid serious failure in the public sanitation system. To replace these lines and to provide *permanent* future protection, a total of 10 miles of Clay Pipe in 8 through 39-inch diameters was installed.

Like Santa Monica, a constantly-growing number of cities all over the country have standardized on Clay Pipe. Clay Pipe is the only pipe that cannot rust, rot, corrode, or disintegrate. And now it's available in new longer lengths with research-developed joints to make the line tighter and easier to install than ever before. Today's Clay Pipe is the only pipe that has *all* the features you can trust. *It never wears out.*

Vitrified **CLAY PIPE** *Never Wears Out*

NATIONAL CLAY PIPE MANUFACTURERS, INC. 1820 N Street, N. W., Washington 6, D. C.

311 High Long Bldg., 5 E. Long St., Columbus 15, Ohio • 703 Ninth & Hill Bldg., Los Angeles 15, California • Box 172, Barrington, Illinois • 206 Mark Bldg., Atlanta 3, Georgia

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Member Audit Bureau of Circulations

47,100 copies of this issue printed

CIVIL ENGINEERING

MAY 1958
VOL. 28 • NO. 5

THE MAGAZINE OF ENGINEERED CONSTRUCTION

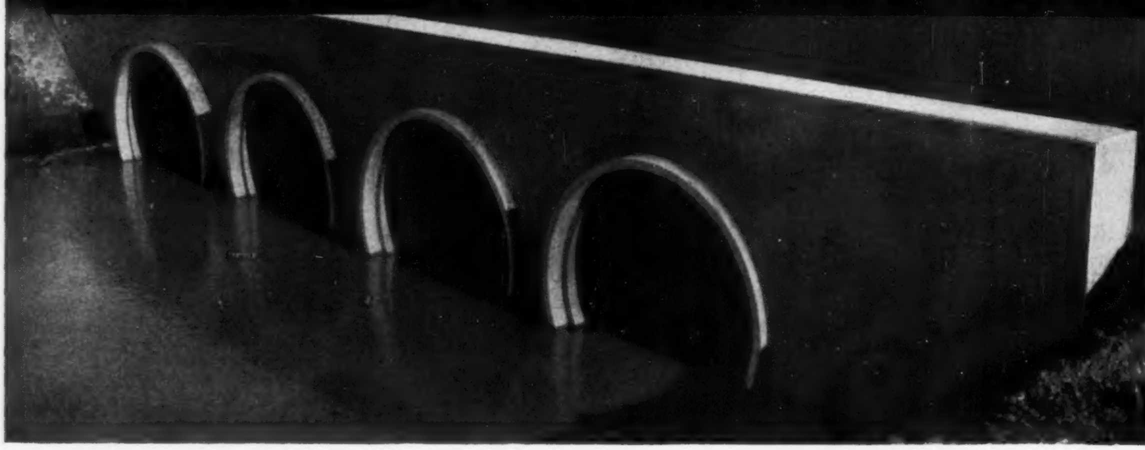
• ARTICLES

• SOCIETY NEWS

• NEWS BRIEFS

• DEPARTMENTS

STRATEGICALLY LOCATED AMERICAN-CONCRETE PRODUCTS FOR MULTI-

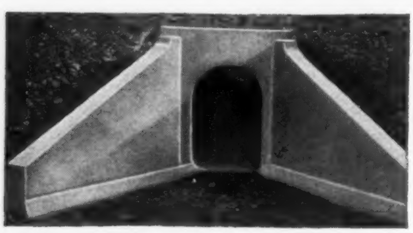


ROUND PIPE

As the nation's largest maker of concrete culvert and drainage pipe, American-Marietta offers contractors round pipe of known permanence and performance. A full range of sizes is available, with pre-tested strengths to meet various specifications. For extreme loads see Hi-Hed Pipe, below.

HI-HED PIPE

Elliptical Hi-Hed Reinforced Concrete Pipe permits greater self-cleansing velocities in dry weather periods. Also perfect for drainage structures under unlimited fills because Hi-Hed has 50% greater strength than its round pipe equivalent.



FLAT BASE PIPE

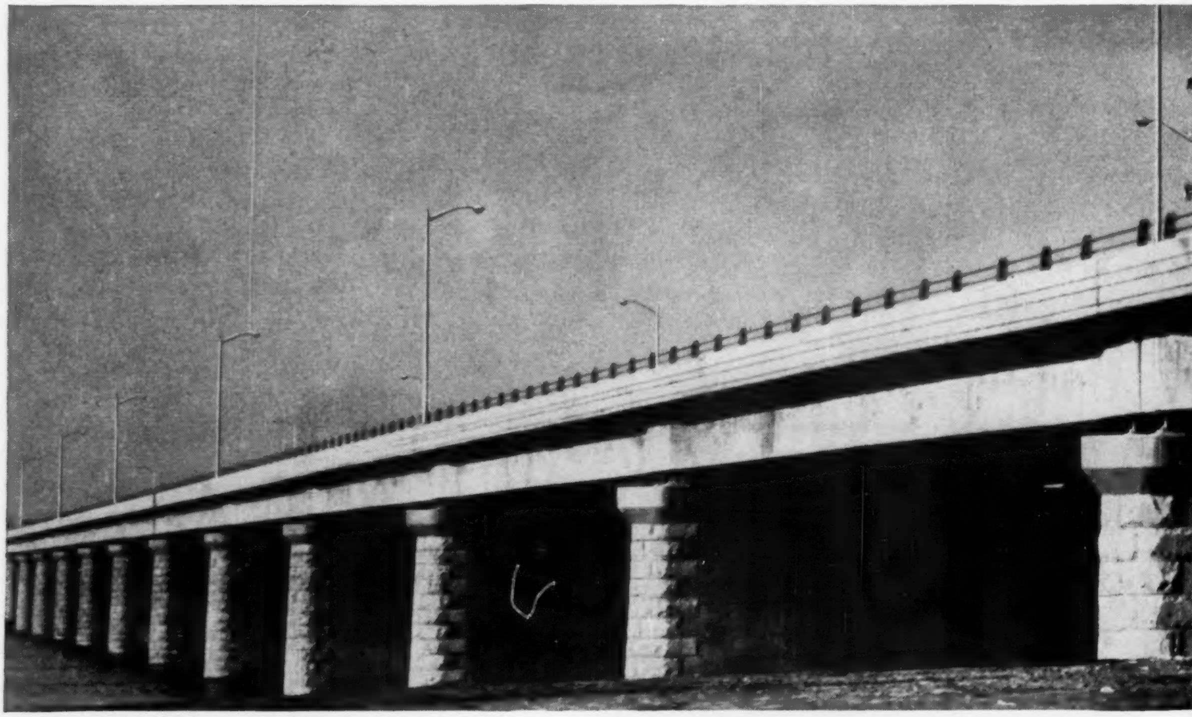
Save as much as 30% in the construction of pedestrian underpasses, culverts and cattle passes with pre-cast Flat-Base Pipe. Can be jacked under highways without disturbing traffic.

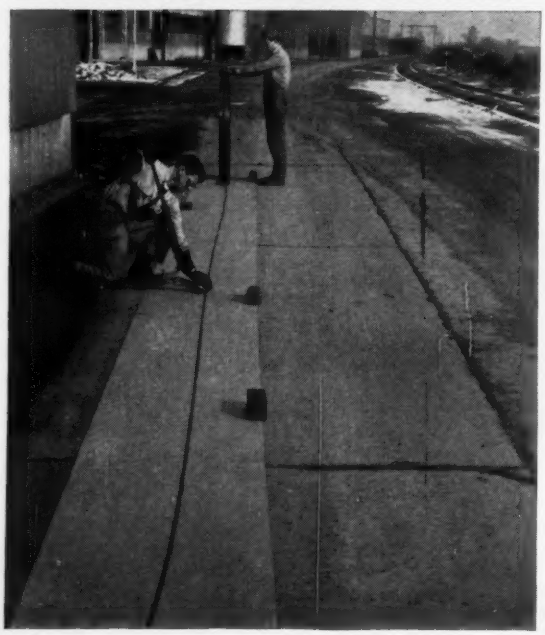
CONCRETE CRIBBING

Used as a retaining wall, both open-faced and closed-face "King-Size" Cribbing offer flexible construction unaffected by movements that crack monolithic walls.

On the Wolcott Avenue Bridge

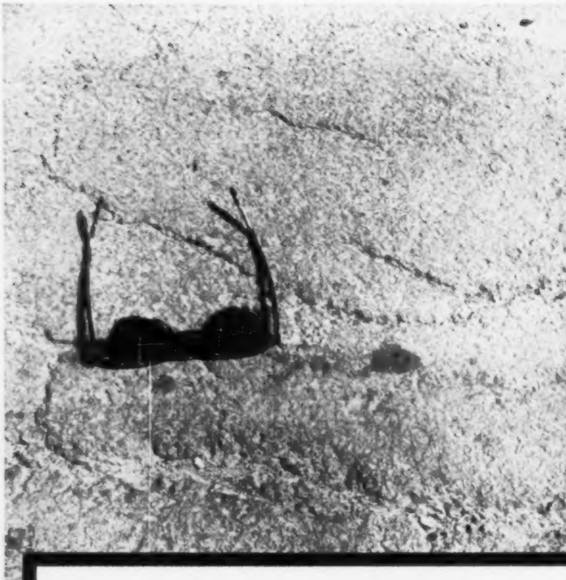
extraordinary straightness of new





Above—This is a partially completed reinforcing assembly for girders in the Wolcott Avenue Bridge. Super-Tens Wires have been inserted in six of the twelve flexible metal tubes in this particular assembly.

Left—This photo emphasizes the superior straightness of USS American Super-Tens Stress-Relieved Wire as it is uncoiled. It stays straight and lies flat, with no tendency to curl, which greatly simplifies handling.



BITUMULS SLURRY SEALS

ARE REAL LIFE SAVERS*

For Pavements in Rochester, New York

*By permission of Beech-Nut Life Savers, Inc., for candies

LEFT: A typical section of pavement to be treated with Bitumuls Slurry Seal in Rochester.
RIGHT: The same pavement section after treatment with Bitumuls Slurry Seal. (Note how the crack in the foreground has been sealed).

The City of Rochester, New York, was faced with a problem common to many communities today: keep all streets maintained in serviceable condition; yet do it at a cost that will permit the complete replacement (out of Maintenance Department funds) of many miles of streets that are over-aged.

Problem: How can you keep overall maintenance costs low enough to permit planned replacement of certain streets?

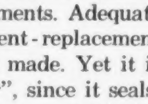
Answer: Bitumuls Slurry Sealing . . . a "life saving" technique for keeping distressed pavements in "good working order". Streets that were badly oxidized, cracked and open-textured due to a combination of age, heavy traffic, and winter weather were readily rejuvenated by the sealing, crack-filling and void-filling properties of Bitumuls® emulsified asphalt slurry.

Bitumuls Slurry Seals actually provided a holding action against wear and weather at extremely low cost. Savings over former methods were pronounced because very-costly winter patching of chuck-holes was completely eliminated. As a result, expenditures for repair and control of winter damage were **reduced by almost seventy percent!**

The money thus saved was diverted to reconstruction of streets that were beyond maintenance or repair.

Bitumuls Slurry Sealing is normally . . . and should be . . . regarded as only a **temporary treatment** for distressed pavements. Adequate repairs or pavement-replacement must eventually be made. Yet it is truly a "Life Saver", since it seals, protects and preserves any basically sound pavement against further deterioration until such a time as major repairs can be made, or the pavement can be replaced.

Typical view of the high-speed, high-efficiency Bitumuls Slurry Sealing in Rochester.



Your community, too, can benefit from the use of Bitumuls Slurry Seals. For further information on Slurry Sealing . . . or for the complete Bitumuls/Life Saver story . . . call our nearest office.

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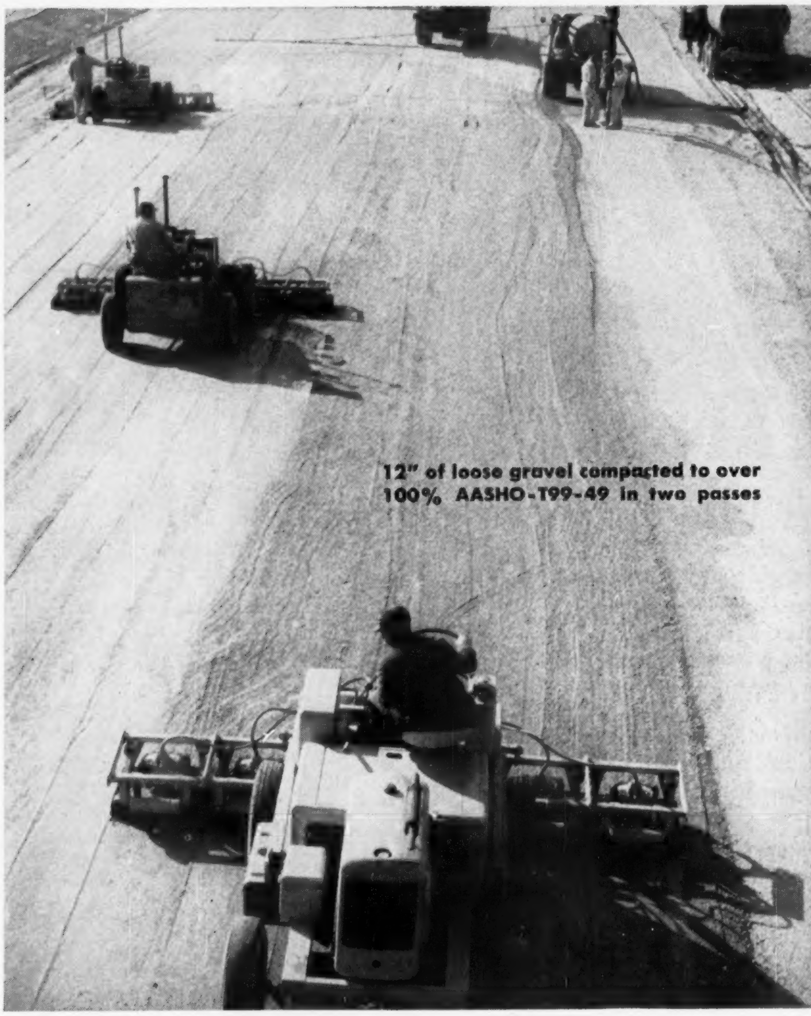
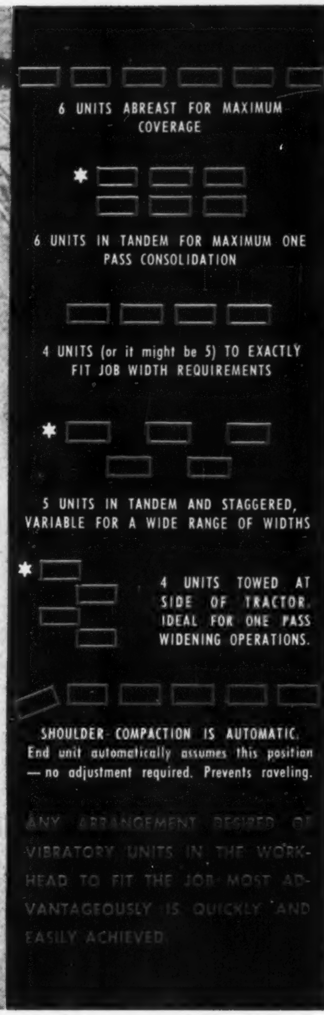
San Juan 23, P. R.





*Attainable with optional equipment.

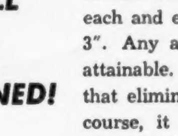
JACKSON COMPACTORS

MORE OF THEM USED ON AMERICAN TURNPIKE PROJECTS THAN ALL OTHER PAN-TYPE COMPACTORS COMBINED!

The reason is two-fold. 1. The JACKSON, with its tremendously powerful vibratory action, provides 100% of specified density of any material normally used in macadam base or sub-base courses in the shortest possible time. Each unit in the workhead supplies 4200 THREE-TON BLOWS per minute. 2. IT'S FAR MORE VERSATILE THAN ANY OTHER COMPACTOR, ideally adjustable to each and every job requirement. Coverage is what you want it to be, up to 13', 3". Any arrangement of the compactor units, as indicated at right, is quickly attainable. With this machine you can compact areas others can't touch, a factor that eliminates lost motion and saves a great deal of time and money. And, of course, it is equally effective on all types of granular soil fills and similar projects. By all means inspect it at your Jackson distributor.

AND FOR SPOTS OTHERS CAN'T REACH

Any of the compacting units in the Jackson Vibratory Compactor workhead can be fitted with operating handle and used exactly like the nationally renowned Jackson Manually Guided Compactors. Perfect for getting into odd spaces and close to walls, etc. — spots that can't be reached by other equipment. One man with a twin hookup of two of these units will compact up to 1,200 sq. yds. of granular soils in 6" layers per hour.



FOR SALE OR RENT AT YOUR JACKSON DISTRIBUTOR

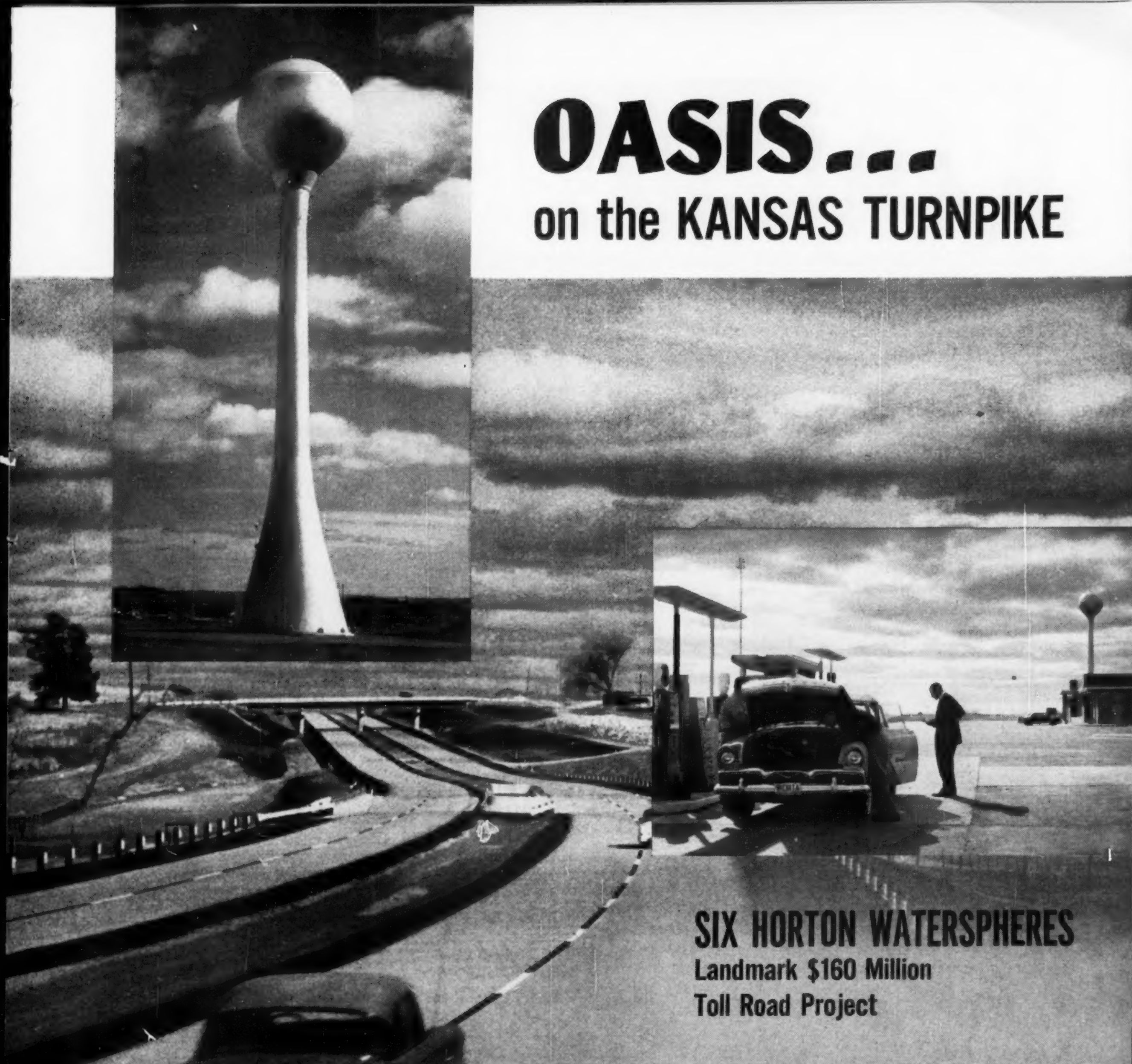
— name and descriptive literature sent on request.

JACKSON VIBRATORS, INC.
LUDINGTON • MICHIGAN

Bridge designers save

The 1,020′ Agate Pass Bridge is of through cantilever truss construction, built with 1,561 tons of steel. 650 tons are USS COR-TEN Steel, a high-strength low-alloy steel that eliminated 300 tons of dead weight and saved $87,000 in total steel costs.

OASIS...
on the KANSAS TURNPIKE



Six 10,000-gal. Horton Waterspheres welcome turnpike travelers to food and motor supplies along the 236 mile route at: Topeka, Emporia, Lawrence, El Dorado, Matfield Green, and Wellington, Kansas.

SIX HORTON WATERSPHERES
Landmark $160 Million Toll Road Project

Opening a new modern route to the Southwest, the Kansas Turnpike passes through 236 miles of the most densely . . . and the most sparsely, populated sections of Kansas.

Six Horton Waterspheres® beckon pike travelers, from a distance, to service areas spaced at 45 mile intervals along the route. Their pleasing symmetry typifies the careful blending of beauty, safety and utility which has marked the commission's planning for this project.

Waterspheres are all-welded structures which require little maintenance and a minimum of ground area for foundations. The base may be utilized for pumping equipment or storage. Built in capacities to 250,000 gallons, Waterspheres provide dependable gravity pressure water storage for general service. Write your nearest CB&I office for details.

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E-48CB

NEWS OF ENGINEERS

Carl S. Ell will retire from the presidency of Northeastern University on June 30, 1959. Dr. Ell is now serving his 48th year with the university and his 18th year as president. During his long tenure with the university he has been chairman of the department of civil engineering, dean of the College of Engineering, dean of the Day Colleges, and vice-president of the university. Northeastern is the largest cooperative plan institution of higher learning in the country. Through a typographical error that is deeply regretted Dr. Ell was incorrectly identified with Northwestern University in the March issue.

Dr. Carl S. Ell

George E. Archibald, concrete-hydraulic engineer, has retired after 17 years with Ebasco Services Incorporated, New York. Mr. Archibald has held several authoritative positions for Ebasco, including work in Brazil and California.

Jack L. Staunton announces the opening of an office as consultant in civil hydraulic engineering. The new office will be located at 60 West 46th Street, New York, N. Y. Mr. Staunton was previously an associate in the New York firm of Seelye, Stevenson, Value & Knecht.

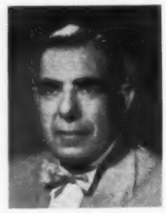
Martin A. Mason, dean of the School of Engineering at George Washington University, has been named to the Board of the Engineering Foundation. The Foundation was founded in 1914 to administer endowment funds for the furtherance of research in science and engineering.

This year marks the 85th anniversary of the founding of the Fruin-Colnon Contracting Company, St. Louis engineers and constructors. For many years, the firm was headed by the late A. P. Greensfelder, Honorary Member of the Society and founder of the ASCE Construction Engineering Prize.

Raymond O. Halvorson has moved to Wenatchee, Wash., with the Rocky Reach Company. He formerly lived in Edmonds, Wash.

Theodore F. Cocks has been appointed sales manager of the Chicago Bridge & Iron Company's new district sales office in Kansas City, Mo. Mr. Cocks has been with the company for six years in various sales positions in Chicago, Salt Lake City, and Birmingham.

E. F. Bespalow has been elected president of the American Concrete Pipe Association. Mr. Bespalow, who is vice-president and chief engineer for Choctaw, Inc., has served as director, vice-president and chairman of the Technical Problems Committee with the Association. He is a past-president of the Mid-South Section of ASCE.



E. F. Bespalow

Johannessen & Girand, consulting engineers, announce the removal of their offices from 415 Central and Washington Building to 3500 North Central Avenue in Phoenix, Ariz.

Edmund A. Prentis is being awarded the 1958 Alexander Hamilton Medal at the annual Alexander Hamilton Dinner of Columbia University. Mr. Prentis, a veteran member of Spencer, White and Prentis, New York engineering firm, has built drydocks for the U.S. Navy, subway tunnels for New York City and foundations for the White House among his many other projects. He will be the 14th recipient of the medal which is awarded annually by the alumni of Columbia to a former student or member of the faculty for "distinguished service in any field of human endeavor."

W. C. G. Church, Captain, Civil Engineer Corps, U.S. Navy has reported as district civil engineer and district public works officer for the Sixth Naval District in Washington, D. C. Captain Church has just returned from a tour of duty in Madrid, where he was the officer in charge of construction for military bases being built in Spain.

C. E. Jacob, groundwater consultant, has moved his office from Orem, Utah to Northridge, Calif. His practice includes water supply, drainage, recharging and salt water control in the United States, Canada, Latin America, the Middle East, and the Orient. Mr. Jacob has served as a hydraulic engineer with the U.S. Geological Survey and as head of the department of geophysics at the University of Utah.

Robert H. Meade, Rear Admiral, U.S. Navy (Ret.), is sworn in as consulting engineer to the New York City Department of Marine and Aviation and to the New York City Council on Port Development and Promotion by Vincent A. G. O'Connor. Admiral Meade, who retired in 1957, was chief of the Bureau of Yards and Docks for two and a half years.

Earle B. Butler has been promoted from lieutenant colonel to colonel in the Army Corps of Engineers. Colonel Butler will continue as commanding officer of the Second Engineer Group with the Eighth Army on assignment in Seoul, Korea. Prior to his current command, Colonel Butler attended the Industrial College of the Armed Forces.

Col. E. B. Butler

Nicholls W. Bowden, chief of the River Control Branch of the Tennessee Valley Authority, has retired after 50 years of public service. Mr. Bowden has been state highway engineer of Louisiana and chief of the projects division of the Corps of Engineers at Pittsburgh. Mr. Bowden, who has been with TVA in supervisory capacities since 1936, has been on several national water resources committees in Washington, D. C.

N. W. Bowden

Three members of ASCE have been named to a nine-man Board of County Consultants for the Bureau of Public Roads, **Bertram Tallamy,** M.ASCE, Federal Highway Administrator announced. The men are: **Joe Abramson,** parish engineer, Caddo Parish, Shreveport, La.; **George W. Deibler,** county engineer, St. Louis County, Duluth, Minn.; and **R. L. Morrison,** county engineer, Forrest and Stone Counties, Hattiesburg, Miss. The Board of County Consultants will handle plans for construction and improvement of secondary roads which are eligible for federal aid.

L. C. Petersen, chief engineer for the New Jersey State Highway Department, has been honored by the New Jersey Prestressed Concrete Manufacturers Association. Mr. Petersen received a special honorable mention award and plaque for the efforts of himself and his department in designing structural prestressed concrete members in bridges throughout the state. Mr. Petersen's efforts are estimated to have saved thousands of dollars for the state.

Andrew M. Braswell, Jr., has been promoted to senior design engineer in the Engineering Division of the Humble Oil & Refining Company's Baytown, Tex., refinery. Mr. Braswell is engaged in the design and coordination of civil engineering work on refinery units.

William R. Walker has been named office engineer for the Portland Cement Association in Chicago. He went there from the U.S. Gypsum Company, where he had been supervisor of property. Mr. Walker is a member of the American Bar Association and Sigma Tau, engineering honorary fraternity.

Robert P. Witt has taken the post of professor in the School of Civil Engineering at Oklahoma State University at Stillwater. Formerly Professor Witt was assistant professor at the Oklahoma Institute of Technology at Oklahoma Agricultural and Mechanical College also at Stillwater.

Edward S. Hopkins announces the removal of his office to 410 Professional Building, 330 North Charles Street, Baltimore, Md. Mr. Hopkins offers consulting services in sanitary engineering and specializes in water supply, sewage disposal, industrial wastes and stream pollution.

Charles J. Wingard is now with the U.S. Forest Service in Orifino, Wash. He was formerly located in Dillon, Mont., as civil engineer for the Forest Service.

James M. Cunningham has recently joined the Jacksonville, Fla., firm of Kemp, Bunch and Jackson, Architects, as a structural engineer. Previously he was structural engineer with Reynolds, Smith and Hills, also of Jacksonville.

Albert A. Erkel

Albert A. Erkel announces the opening of a new office for Albert A. Erkel & Associates, Consulting Structural Engineers, at 3515 Cahuenga Boulevard in Los Angeles, Calif. The firm, which was originated early last year, is engaged in major engineering projects for Northrop Airlines, Inc., and Los Angeles County.

A. W. Coutris announces the establishment of a consulting firm in Paris, 62 Rue Spontini. Mr. Coutris was previously with Moran, Proctor, Mueser and Rutledge, New York consultants. He took part in the analytical studies for the Texas Towers, advance radar warning stations.

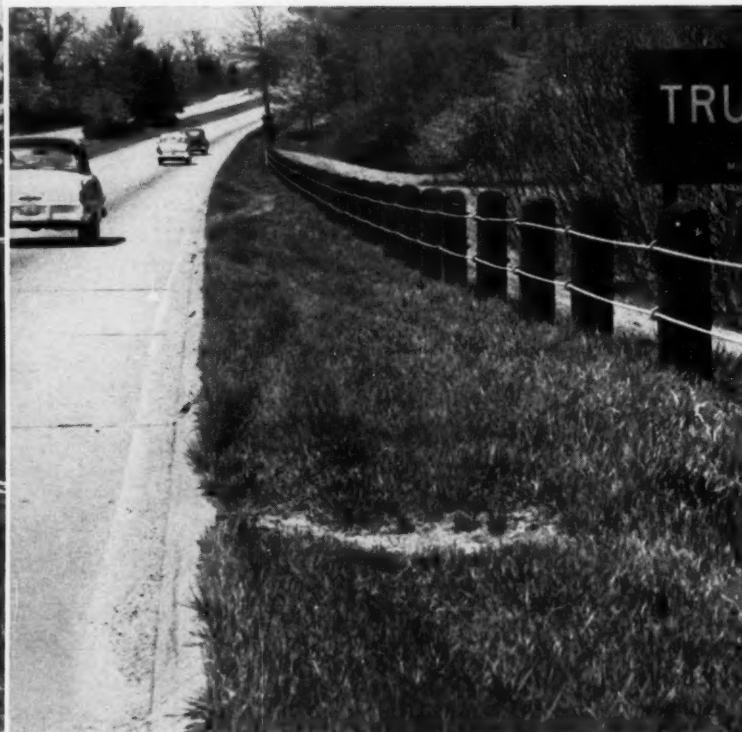
Grant E. Meyer has been appointed division engineer for the Bureau of Public Roads in Salt Lake City. Formerly Mr. Meyer held the post of district engineer for the Montana division of the Bureau in Missoula, Mont.

Robert L. Armstrong will be in charge of the new Western District Sales Office of the Henry Pratt Company. The new office will be situated in Los Angeles and will provide liaison with sales representatives throughout the West.

(Continued on page 110)

Theodore E. Siler, construction management engineer at the U.S. Army Engineer Gulf District Office in Tehran, Iran, receives the U. S. Air Force Medal for "exceptional civilian service," from Brig. Gen. A. P. Clark. The scene of the award ceremony is the spot where an air transport crashed and Mr. Siler rescued 14 survivors from the burning plane. Shown with Mr. Siler are (left to right) General Clark, Col. Leigh C. Fairbanks, and Maj. Norman L. Williams.

Mr. Clinton Peterson, Division Engineer of Maintenance, says, "Pressure-creosoted posts are the best and most economical. They last from 25 to 30 years."

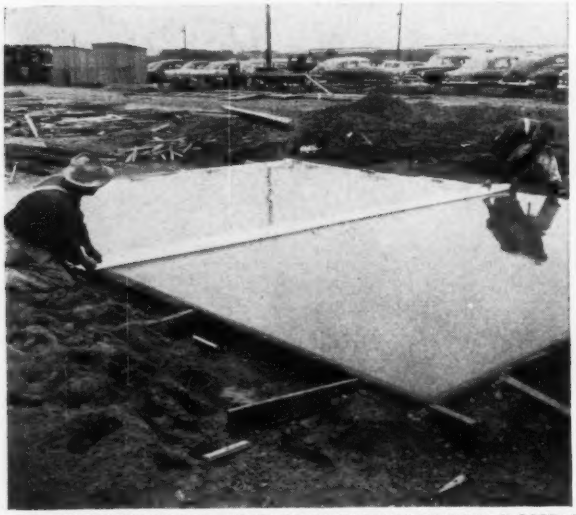


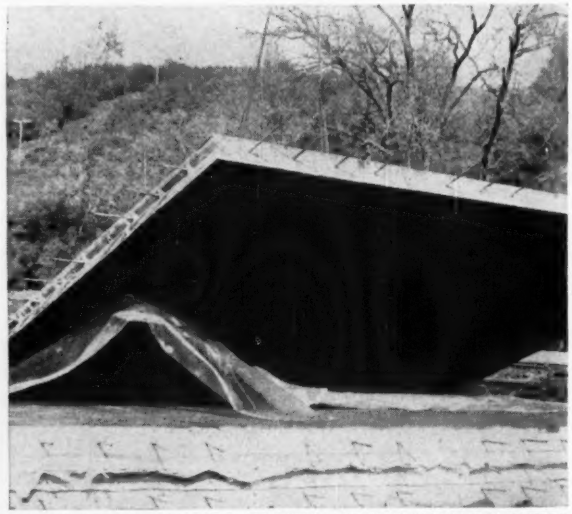
The Merritt Parkway in Connecticut, opened in 1938, was one of the first of the modern toll roads. The original rustic guard rails were generally of oak or chestnut dipped in a preservative bath. These showed early signs of deterioration according to Mr. Clinton R. Peterson, Division Engineer of Maintenance. Some of the posts lasted only five to ten years—and replacement was costly.

Obviously a change had to be made to save taxpayers' money. Wood preservation experts from the highway department, a university forestry school and the Connecticut Agricultural Experiment Station began a study. After much experimentation, the conference reported

Posts untreated
rot out in 5 to 10 years.

A BETTER CURE FOR CONCRETE PROBLEMS





FOR ECONOMICAL TILT-UP CONSTRUCTION: BOND-BREAKER CURING BLANKETS OF "VISQUEEN" FILM give these added advantages: (1) Stronger cures. (2) Each section comes away easily—leaves surface clean and smooth.

FOR SLAB FLOOR: CURING BLANKETS OF "VISQUEEN" FILM give you these added advantages: (1) Slow, even, stronger cures. (2) No watering needed. You save time, labor. (3) Film *stays* light, is re-usable.

FOR ROAD CONSTRUCTION: CURING BLANKETS OF "VISQUEEN" FILM give you these added advantages: (1) Core test strengths prove stronger cures with greater economy. (2) Low first cost—plus up to 23 re-uses cut blanket cost to fraction of cent/ sq. ft. (3) Light weight saves labor. No watering necessary. Film rolls up easily.

Needs No Special Handling or Drying. Will Not Rot, Mildew. Inert-No Chemical Reactions With Concrete. White Opaque Film (reflects heat) Comes in Wide Range of Widths Including 14′ Rolls With No Folds and Seamless Widths Up To 32′. Write Now-or Use Information Request Tag For Details.

information request tag
VisQueen®
Trade Mark
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VISQUEEN *film—the first and foremost polyethylene film. A product of the long experience and outstanding research of* **VISKING COMPANY** *Division of* UNION CARBIDE *Corporation*
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. . . . . Am-Soc Briefs

▶ ▶ On the education front. . . . After study of the San Diego Section's revealing survey of high school students, with its finding that lack of scholarships does not keep young people from choosing careers in science and engineering, the Society has made an important policy statement. Through its Executive Committee, it urges that any Federal funds available for education should be devoted to encouraging graduate study and improving teaching at all levels. This means the Society does not go along with the Administration's proposal for huge Federal grants for undergraduate scholarships in science and engineering.

▶ ▶ Professional stamps only. . . . In another significant Executive Committee action, ASCE has endorsed a recent Los Angeles Section resolution opposing the use of union labels on engineering plans. The Section's resolution supported a stand taken by the Los Angeles Board of Public works.

▶ ▶ Competitive bidding denounced again. . . . Indirect support for the Society's stand against bidding for professional services comes from the American Bar Association. The ABA has opposed bidding for lawyers' services as a "violation of the Canons of Professional Ethics of the Association." Details in "Society News."

▶ ▶ Financing the United Engineering Center. . . . ASCE's assigned share of $800,000 toward construction of the new United Engineering Center is only 8 percent of the estimated total cost of $10,000,000. However, the gift of every member (outright or by three-year pledge) will be needed to meet our quota.

▶ ▶ Power and hydraulic engineers. . . . This is to alert you to a once-in-a-lifetime chance to attend an important series of international meetings slated for Montreal and New York City this September. The three meetings will be followed by three week-long Study Tours covering the whole country. . . . Attendance must be arranged well in advance (see page 85 for details).

▶ ▶ Speaking of meetings. . . . The Structural Division's Committee on Electronic Computation is planning a November conference on structural applications in the field. Qualified authors for program papers are being sought. . . . For how to go about it see "Division Doings."

▶ ▶ ASCE Membership Directory. . . . As a member of the Society, you are entitled to a free copy of the 1958 Directory of Members, the first in two years. Order forms will be in the mail for every member in the next few weeks. Please see that your form is filled out and returned promptly.


are your plans
as precise
as your planning?
The proof of the planning is in the finished plans. That's why you're smart to use Eagle TURQUOISE —the pencil that tops 'em all for reproduction. Look what it gives you: Uniform grading (17 scientific formulas guarantee exactly the blackness you want —from every pencil, every time!). A strong non-crumbling needle point that stays sharp for line after long line of unchanging width. Inimitable smoothness —thanks to Eagle's exclusive "Electronic" graphite—TURQUOISE makes your plans look sharp—and you, too!
WRITE FOR FREE SAMPLE: Turquoise wood pencil and Cleantex Eraser, naming this magazine—or buy any of these drawing instruments from your favorite dealer.
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do you know that

This special issue is devoted to high-speed electronic digital computers? The practical business of realizing the almost unlimited potential of these miracle machines —one of the great challenges and great opportunities facing today's civil engineer—is the general theme of the eleven papers comprising the issue.

• • •

Computers have become a multi-million-dollar industry? Prices commonly range between $40,000 and $250,000, with some special-purpose units costing as much as $4,000,000. Some of the largest and most expensive machines rent for all of $35,000 a month. Even so, in the long run and after volume application, firms using computers expect to realize a profit on their investment.

• • •

Over 100 civil engineering firms already have their own computers? Some 40 state highway departments have also taken the big step, and other firms and highway commissions are thinking seriously of following suit. As one partner in a prominent civil engineering firm puts it, the firm has installed a computer "for the purpose of advancing the profession and allowing us to serve clients better by providing better results more quickly."

• • •

Municipalities are using them, too? On a recent New York City crash program for completing the design of the Harlem River Drive, use of a IBM 704 electronic digital computer saved 420 man hours—roughly about twelve weeks of one engineer's time. The complex problem, involving the design of 300 composite stringers for two elevated highway structures, took 15 minutes of machine time for solution.

• • •

Technical personnel will not be displaced by computers? Since the electronic "brain" is only as good as the human brain that feeds it data, there need be no fear that it will replace engineers and technicians. Actually higher professional capacity and better trained personnel will be required to keep up with the computer's pace and make optimum use of it. This is the consensus of computer papers presented at the winter general meeting of the AIEE.

• • •

A typical useful application will be in handling the current AASHO road test data? If computers were not used for processing and analyzing the tremendous mass of material developed in the road test being run at Ottawa, Ill., from ten to fifteen years would be required for completing the AASHO's final report.

• • •

A higher level of accuracy is needed in giving work to computers? According to S. L. Seaton, consulting engineer of Hampton, Va., human beings make about one error in each 200 digits transferred, but "machines operate with essentially no errors." In addition to stressing the need for greater accuracy in giving work to machines, Mr. Seaton urges that "every means possible be employed to eliminate humans in the data-processing chain."

• • •

A computer device will measure and meter the use of electricity in Chicago? The Commonwealth Edison Company is installing one of the first units in the country to combine complete computer and generation control elements. In addition to measuring the moment-to-moment use of electricity by 1,940,000 Chicago customers, the device will make for economical and efficient operation by automatically distributing production as needed among the twelve Edison stations serving the area.

• • •

Computers are being found in university settings? To speed basic research the University of Pennsylvania has established a Computer Center—built around a $1,440,000 Univac system, the gift of the Sperry Rand Corporation. The dozen vital programs currently underway include a study of the behavior of framed structures, under the direction of Sidney Shore, J.M. ASCE, associate professor of civil engineering at the university.

• • •

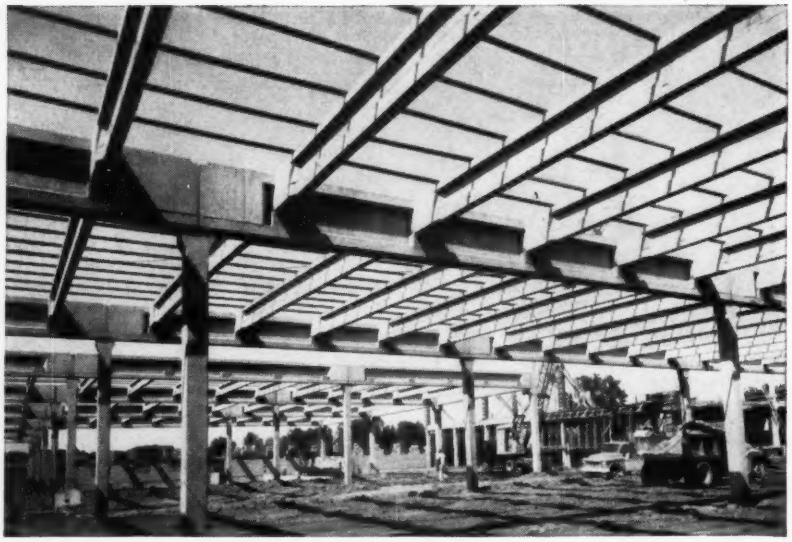
In automobile manufacturing the computer is useful, too? General Motors, for instance, can build and test complete free-piston engine systems mathematically on its Technical Center digital computer. The computer-produced models give engineers such an accurate analysis of what actual engines will do in service that countless cut-and-try experiments with prototypes are no longer necessary.

• • •

One computer has the distinction of having a planet named after it? The machine is the Naval Ordnance Research Calculator (NORC), a large IBM unit built for the Navy (page 101). The planet namesake was discovered in 1953 and named in 1957 after its orbit had been established entirely on the basis of calculations provided by Computer NORC.

STRESSING

A STRUCTURAL TRIUMPH



Prestressed 'Incor' Structural Members Frame 72,000 Sq. Ft. of New Sanitary Food Plant

• Sanitation and cleanliness are of paramount importance in food processing. How better can these essentials be obtained than with precast, prestressed concrete!

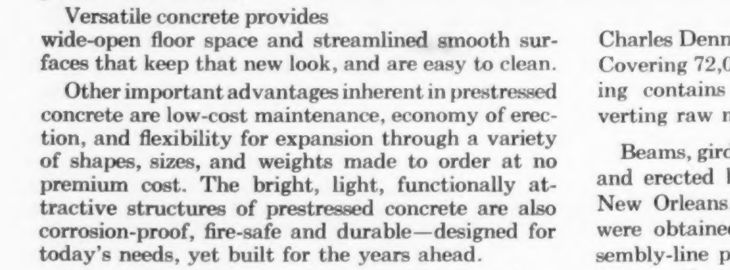
Versatile concrete provides wide-open floor space and streamlined smooth surfaces that keep that new look, and are easy to clean.

Other important advantages inherent in prestressed concrete are low-cost maintenance, economy of erection, and flexibility for expansion through a variety of shapes, sizes, and weights made to order at no premium cost. The bright, light, functionally attractive structures of prestressed concrete are also corrosion-proof, fire-safe and durable—designed for today's needs, yet built for the years ahead.

Noteworthy is this large modern structure which houses the multiple food processing facilities of Charles Dennery, Inc. in Jefferson Parish, Louisiana. Covering 72,000 square feet, the well-designed building contains the plant's varied operations—converting raw materials into packaged food products.

Beams, girders, purlins, and columns were supplied and erected by Belden Concrete Products, Inc. of New Orleans. A quick start and early completion were obtained using 'Incor'*, making possible assembly-line production, fast stripping and re-use of forms—advantages always assured with America's FIRST high early strength portland cement.

*Reg. U.S. Pat. Off.



FOOD PROCESSING PLANT
WAREHOUSE AND OFFICE BUILDING
Jefferson Parish, Louisiana

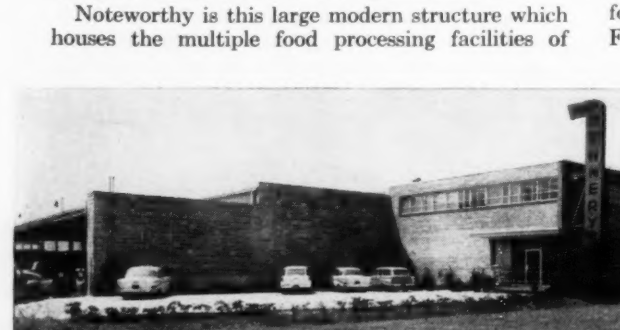
Owner: **CHARLES DENNERY, INC.**

Architect: **AUGUST PEREZ & ASSOCIATES**

General Contractor
LIONEL F. FAVRET CO., INC.

Prestressed Units Supplied and Erected by:
BELDEN CONCRETE PRODUCTS, INC.

All of New Orleans, Louisiana



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A revolution in design practice

NATHAN M. NEWMARK, M. ASCE, Chairman, Structural Division Committee on Electronic Computation

Professor of Civil Engineering and Head of Department, University of Illinois, Urbana, Ill.

The high-speed electronic digital computer has brought about a revolution in engineering analysis and design—a revolution that is just now gathering momentum and one that will have far-reaching consequences in engineering practice and in engineering education.

This discussion is concerned with the concepts and the philosophy of high-speed computation, not with the hardware. It is assumed that the reader knows something about the use of high-speed computers, of their speed, which can range upward of a thousand times that of a human operator with a desk calculator, and of their complexity, which allows them to make choices or select alternatives in an almost human, though programmed fashion.

It is the "programming" of a sequence of operations, with internally determined alternatives, that has brought automation to engineering analysis and design. However, it is the fantastically high computational speeds that will revolutionize methods and techniques, and possibly even our philosophy. The present thousand-fold increase in speed, as compared to the fastest mechanical calculator, is as great as the power of the kilaton A-bomb of a decade ago when compared with that of the high-explosive bomb of World War II. And, having the comparison with the H-bomb in mind (another thousand-fold increase), in two or three years we shall see speeds, if not a million times as fast as those of a desk calculator, at least hundreds of thousands of times faster.

Consider the analysis of a specific engineering structure involving the use of standard materials, where the dimensions and loads are known. Such an analysis involves the calculation of the stresses or deflections, by more or less precise means or, usually with less precision, the determination of useful strength. For every defined analytical procedure, however crude or however accurate, it is now possible to program the solution for a computer, which can generally do the job much faster and with fewer mistakes than a human operator. Now and for a short while longer, because of the shortage of manpower, designers will be interested in the programming of procedures which use the crude, partly empirical calculations on which present specifications and handbooks are based. But the waste in such procedures, the paradoxes and the incompatibilities they entail, will cause a renewed interest in more exact methods of analysis. We shall be concerned with non-linear relations of stress and strain, space frames rather than plane frames, and similar problems. Then we shall also need more accurate knowledge of materials.

But what of "design?" This has meant in most cases merely an analytical test of an assumed structure, with a subsequent strengthening of members or elements which are overstressed or in which failure occurs prematurely. By this step-by-step modification of proportions, a structure emerges which satisfies all the criteria. This works fine for statically determinate structures. But for indeterminate structures where does the designer start? In many important cases his starting point, and the way he patterns the modifications, determine what he ends up with. There may be several possible endpoints, and the "natural" result from the most obvious beginning may not be the best choice. Much further study and research are needed to make the most effective use of computers in design. The surface has barely been scratched.

There are really two design problems. One is the preliminary design, the starting point, the rough but quick first estimate. This is worth programming if only to avoid errors. The other is the more accurate final solution leading to the proportioning of the most economical of the various alternative types. Often we may find that time and simplicity of construction are so overwhelmingly important that the preliminary design is the best.

In structural analysis and design we are in the first phase of the revolution now. We tend to use computers, because of the gain in speed or in productivity, along with methods that are outmoded or at least inaccurate and undependable. In essence we tend to use precise methods of approximate calculation. The next step is the development and use of more accurate analytical procedures. We are entering this phase now, in part. But we must look forward eventually to the development of more fully automated design techniques. This implies more sophisticated design criteria and more rationally based design specifications. When that time comes it will certainly be the end of the handbook engineer.

And what of the impact of the computer on civil engineering education? It is essential that we supply the engineer of the future with the education that will permit him to make the most effective use of the new tool. It is not so important for the graduating civil engineer to know how to use a specific computer as it is for him to know something of the general principles of high-speed computation, to have a grounding in the techniques of numerical analysis, and above all, to have training in the more precise methods of analysis which will be in common use in the near future.

The entire basis of civil engineering design and analysis will change in the next twenty years, and the cause of the change will be the electronic digital computer.

CHOOSING YOUR DIGITAL

J. P. NASH, Missile Systems Division, Lockheed Aircraft Corporation, Palo Alto, Calif.

A few years ago it was necessary to tell an engineer what a digital computer was and why we regarded it as such a powerful engineering tool. Today it is no more necessary to describe a digital computer than it is to tell an American boy how to recognize a sports car. Nearly every engineer knows in a general sort of way what a digital computer can do—at least he knows that it can do a lot of things that were impossible before the digital computer came along. He also knows that the computer has great versatility and can handle an almost unlimited variety of tasks ranging from the composition of music in the style of Scarlatti to the design of highway bridges. A numerical problem, he finds, can be solved on any digital computer. But if he wants to buy or lease a machine, he finds that there is no clear-cut way of choosing the "best" machine for his problem—or if there is, a different problem may not yield such a clean decision.

The general design of most computers available today is pretty well standardized in the same way that American automobiles are standardized. Our automobiles all have four wheels, operate on gasoline, have the motor in the front, the steering wheel on the left, and have tail fins and too much chrome. Structural details differ in such things as the number of cylinders, the type of carburetion, the type of automatic shift, the type of steering, the amount of trunk space, and so on. Each car will do about the same thing, but one may be superior for a traveling salesman and another for a housewife. If you can drive one, you can drive another, but it may take a little time to learn the characteristics of a new one and to run it efficiently.

Computers are designed around a central arithmetic processing unit, usually called the arithmetic unit, and have three other basic supporting units: an input-output unit (which may be a multiplicity of separate things) for communicating between the computer and the outside world, a memory unit for storing the instructions to be followed and the quantities to be worked with, and a control unit to supervise the proper sequencing of the many operations to be carried out. Although all computing systems have a general design based on these four units, they differ markedly from one another in details.

The result is that people interested in the use of computers often find themselves asking the question, "Is one computer better than another?" They want to know how digital machines differ from one another. Are there real differences or is it largely a matter of personal preference? Is choosing one like picking between Ford and Plymouth and Chevrolet, or is it more like the choice between a Jeep and a Cadillac? What characteristics are important in the consideration of a machine?

It may not always be easy to tell. A digital computer can mean many things to many people. Today it is possible to buy an electronic digital computer for almost any price between $40,000 and $4,000,000 or more. These are prices differing by a factor of 100, and today that is about the factor between a bicycle and a Chrysler Imperial. It is pretty clear that unless there are big differences in computers, somebody is paying too much for what he gets.

There are also big differences in power requirements and in size. The NORC at the Naval Proving Ground uses 168 kw of power and occupies 3,500 sq ft of space. (See "A Second Survey of Domestic Electronic Digital Computing Systems," by Martin H. Weik, Ballistic Research Laboratories Report No. 1010, June 1957.) Philco's TRANSAC S-2000 uses 1.5 kw and needs about 200 sq ft of space. It weighs 1,500 lb and costs something like $1,000,000. That is about $600 per lb. It is fair to say that the price per pound of computers is rising today, but it should also be added that efforts to evaluate digital systems by this criterion have not been successful.

In order to judge a computing system, it is necessary to look at details and to make assessments while continually bearing in mind the general class of problems to be solved. For, while nearly all machines of interest to people solving engineering problems are general-purpose computers, most organizations requiring a computer have a preponderance of problems in a single class or in a limited number of classes. For example, if a large fraction of machine use is to be for the solution of ordinary differential equations, it would be a mistake to acquire a computer with elaborate input and output facilities because these would have little application to the problems to be solved. Indeed, perhaps an analog computer should be considered rather than a digital machine.

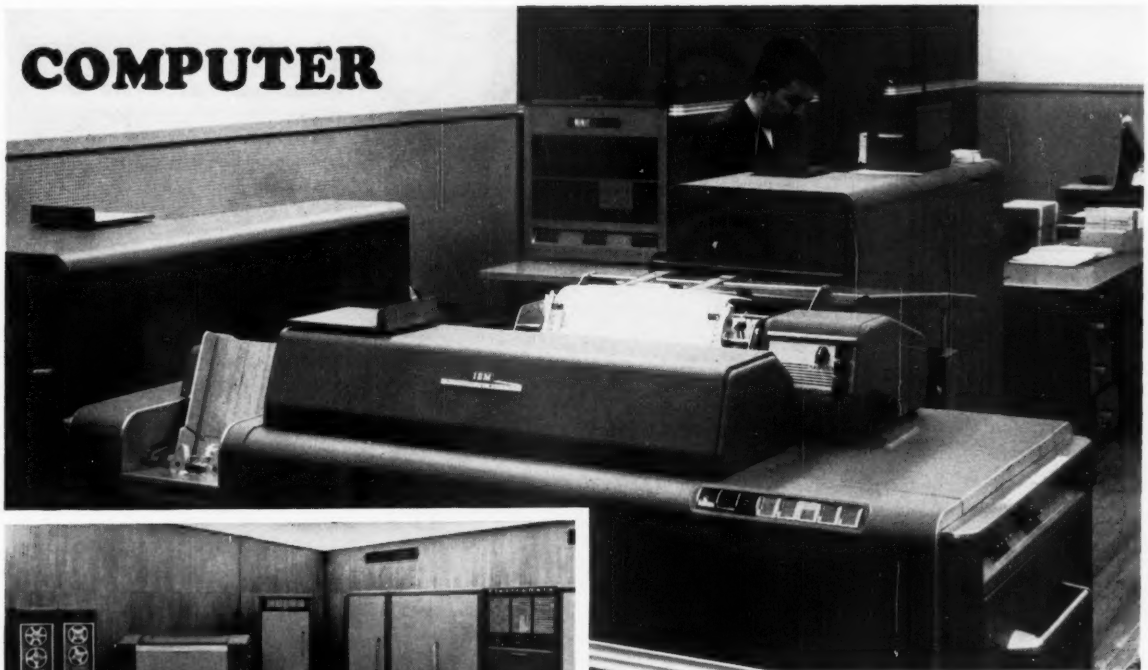
Let us list some of the general characteristics of computers and then take a more detailed look at the particular features of interest to people interested in engineering applications. It will then be possible to have a better understanding of what is offered by some of the machines now available.

The following characteristics include all those which ordinarily need to be considered in the evaluation of a digital computer:

1. Numerical system
2. Type of arithmetic unit
3. Storage
4. Input-output
5. Power, space and weight
6. Cost
7. Personnel requirements
8. Speed
9. Reliability

These nine basic characteristics have many subdivisions and any one of them could form the basis for a lengthy discussion. Comments on some of the major points follow.

COMPUTER



Building-block principle of growth is used in data processing system in which IBM 650 is the basic building block. This magnetic-drum machine stores 2,000 ten-digit words. Purchase price of the basic IBM 650 is $182,400; monthly rental, $3,750.

Speed of Burroughs Datatron 205 is increased by having needed words rewritten several times on short tracks around the magnetic drum in recirculating loops.

1. Numerical system

Digital computers work with the digits of numbers, and most of them have numbers with a fixed number of digits—say 10 or 12 if the decimal system is used, or 36 or 40 if the binary system is used. Since the instructions obeyed by the computer are nothing more than encoded numbers, it is convenient for the machine designer to have the numbers and the instructions consist of the same number of digits. Such a collection of digits, whether a number or an instruction, is called a word.

In discussing the numerical structure of a digital computer there are four topics worth mentioning.

Number system used. Is it binary or decimal? Binary machines are simpler to build than decimal machines and, except for problems involving large amounts of input and output, are preferable because of their less complex structure. Certainly, in scientific and engineering calculations there is no good reason for requiring a machine with an internal decimal number system. The unfamiliar binary system is no problem for the user because the machine can easily convert to and from its customer's decimal notation. The trend is back toward the binary system.

Word length. Most digital computers work with words of about 10 or 12 decimal places or the binary equivalent. Smaller words allow faster arithmetic but may be too short to permit the accuracy desired without going to elaborate programming procedures which slow computations again. The Bendix G-15A is an example of a machine with an unusual arithmetic design which allows double precision calculations without the usual penalty.

Fixed or floating point. Are all the computations done with numbers having the decimal point in the same place? One of the things that distresses many new users of so-called "fixed-point" computers is the requirement that every number used by the machine be restricted to lie between two fixed quantities such as -1 and $+1$. This is the problem of "scaling a computation," and it is one of the things that a programmer must learn to do. However, it is possible to build a machine that does not always have its decimal point in the same place. We then have a "floating-point" machine which represents each number by two quantities, a fraction smaller than unity and an integer representing a power of 10 (or of 2 if the binary system is used). This is a notation similar to that used for logarithms where we have a fractional mantissa and an integral characteristic. A floating-point machine would represent the number 500 by the two quantities 0.5 and 3, where 3 is the power of 10 by which 0.5 must be multiplied to give 500.

The use of internal number systems of this kind complicates computer design (thus raising the price), but it simplifies programming and therefore makes it easier to find one of today's very scarce commodities, the computer programmer.

A multiply time of 250 microsec, including required access times for operands and instructions, is a feature of the fast Remington-Rand 1103 A (UNIVAC), which costs about $1,500,000.

Computer language. A computer operates by carrying out a sequence of instructions expressed in a language called the instruction code. The language contains terms like "add," "subtract," "multiply," "print," "read," "transfer," and many more. Most machines have an instruction code of from 30 to 60 instructions, and no two manufacturers use the same code—not even within their own product lines. The result is that there are as many codes as there are kinds of machines—the computer world has developed its own Tower of Babel.

It is possible today to buy a machine which will translate computer languages, and there are many computer people concerned about the problem. It is unlikely that it will ever be solved, any more than we will all ever agree on the metric system or a calendar reform or on the proper length for women's skirts. But neither will it hold back progress in computers. Engineers often have to translate from the English system to the metric system when they work outside the United States, but it does not seem to have any adverse effect on the quality of their work.

2. Arithmetic unit

It is in the Arithmetic Unit and in the Memory that the speed of the computer is determined. Most small or medium-sized computers have a serial arithmetic unit. They add a pair of numbers just as a human being does with paper and pencil, beginning at the right-hand end, adding the two end digits, and moving one step at a time to the left. But addition does not have to be done this way just because of the limitations of human beings. A machine can be designed to add all the digits of the two numbers at once, thus greatly speeding up multiplication and division as well as addition because these arithmetic operations are usually carried out by successions of additions. Adding all the digits at once, called parallel addition, is more expensive because it requires a much more complex arithmetic unit than the one-digit-at-a-time method, called serial addition. It also requires a different kind of storage because the arithmetic unit must have all the digits of both numbers at the same time, whereas in the serial machine only one digit from each number is needed at any one time.

3. Storage

Storage, or memory, is the greatest single factor in determining the over-all characteristics of a computing system. It is the internal storage that makes the digital computer what it is, for without it we would be unable to remove the human being from the computational cycle. The storage holds all the instructions and numbers required for a computation, and today it dominates the design of new machines, for we do not today know how to bring numbers out of a reasonably large memory at a speed that can keep up with arithmetic processing speeds without greatly complicating the internal structure of the arithmetic unit and control unit.

As may be inferred from the remarks about arithmetic units, computer memories are also serial or parallel in nature, depending upon whether they handle words one digit at a time or all digits at once. The fastest machines today have parallel memories with capacities of 8,000 words or more. These memories are now composed almost exclusively of magnetic cores which have in turn replaced cathode ray tubes used in the Williams memory. Access time for fast core memories is a few miscroseconds.

The cheapest computer memory with reasonable access time, size and reliability is the magnetic drum, and it is used on all the small and medium-sized machines. Access time is determined by the rotation speed of the drum, and it can be seen that a drum rotating at 3,600 revolutions per minute (60 revolutions per second) might require as much as 1/60 sec to begin to read out a word that had just passed the reading head and must go around again. This would be 17 milleseconds (17,000 microseconds) compared with perhaps 8 microseconds for a magnetic core memory. The access time for the IBM 650 is reduced by having its drum turn at 12,500 rpm. The access problem can also be avoided to some extent by arranging the computation in an ingenious way, known as optimum programming, so that the appropriate word is at the reading head when it is needed, or by having needed words rewritten several times on short tracks around the drum in recirculating loops. This last technique is used by the Burroughs Datatron. The Bendix G-15A is designed to *make* the programmer do optimum programming.

There are other storage devices in use and being investigated (such as ferroelectric elements, thin magnetic films, and spin-echo techniques) but available machines today will have magnetic-core or magnetic-drum memories or some variation of the drum, such as a magnetic disk.

4. Input-output

The computer user or the casual observer is ordinarily more aware of the input-output facilities than of anything else associated with the machine. For one thing, he deals with them in his association with the machine. For another, they are mechanical and show some physical activity, in some cases making loud noises.

Today input is the least sophisticated of all operations done by computers.

By arranging pins in eight pin-boards at right, operator gives instructions to Burroughs Electrodata 101. This computer uses the decimal system.

It is still necessary for a human being to prepare by some manual method any new material to be presented to the machine. Instructions and data, no matter how neatly or intelligibly they may be written on paper, must still be copied onto some special medium for the computer. In a few years, our present researches in character recognition will lead to automatic reading machines, but we are not yet able to do more than primitive machine reading.

The most common basic input medium in use today is the punched card, followed by punched paper tape. There is some reason for thinking that paper tape is underrated, for its serial nature gives it advantages over cards in many applications, and it will be satisfying for some people to see IBM use paper tape on its new 610 computer.

Magnetic tape is also used as a primary input medium, but it is more often used in a secondary way for storage of often-used programs that were first prepared in one of the other media.

Output of digital computers is much more varied than input. Results of computations can be punched on cards or paper tape or recorded on magnetic tape for later conversion to forms usable by humans. These forms may be printed or plotted. The computer may display results on a cathode-ray tube which is automatically photographed. Or it may print directly on a printer at speeds ranging from 10 characters per second to 2,000 characters per second.

Most computer manufacturers today offer their customers a wide range of input and output accessories.

5. Power, space and weight

Except on the very large computers, the size and power requirements are not enormously important because they are not great. Even the most expensive machines are soon going to be small. We are now seeing the last of the vacuum-tube machines, and the next generation of computers will be made with transistors which will vastly reduce the size and power requirements. Peripheral equipment, such as magnetic tape units, will still be about the same size.

6. Cost

As we have seen, computers vary widely in cost. But, as any student of supply and demand knows, computers that do comparable things will cost about the same in our competitive economy or pretty soon the high-priced computer manufacturer will be out of business. Computers today can be purchased or leased, and most users prefer to lease, thus avoiding expenditure of their own capital and reducing the chances of later owning obsolete equipment. Monthly lease costs are usually about 1/50th or 1/60th of the sale price.

Cost is something that sometimes shocks the prospective buyer of a computer. The engineer is unaccustomed to using equipment for which costs are specifically given as high as several hundred dollars per hour. The shock arises because of an improper perspective about computer use. We are not interested in how many dollars per hour a computer costs but in how many multiplications we can do per dollar. Thus cost is a matter of utiliza-

Output data from a computer in the form of punched cards or tape can be used as input for plotters such as this Benson-Lehner Electroplotter Model H. Plotter then plots cross-sections or profiles almost entirely automatically.

tion, and it is well known that the cheapest computing is obtained from the biggest and fastest and most expensive machines *provided that* they have enough work to keep them busy. For example, let us compare the approximately $1,500,000 cost of the Remington-Rand 1103A with the $50,000 Bendix G-15A. The 1103A has a multiply time of about 250 microseconds, including the required access times for operands and instructions, while the time for the G-15A for an equivalent precision is about 20,000 microseconds. Thus, although the 1103A costs 30 times the G-15A, its multiply speed is about 80 times greater. Of course factors other than multiply speed need to be considered in computer cost analyses, but the general concept is valid. The most expensive way to do routine arithmetic is to let an engineer use a desk calculator.

7. Personnel requirements

It may seem a bit strange to put personnel requirements in with computer characteristics, but until machines get more automatic than they are today, they have to be considered in connection with the people around them. For machines of about the same capacity, personnel requirements are similar. A good rule of thumb is that a large-scale computer such as the IBM 704 or the Remington-Rand 1103A, which is doing a variety of jobs, will need about 35 people to keep it running and occupied. Smaller machines of the medium-speed kind will need 3 or 4 people besides the maintenance man required for one-shift operation.

It is hard to say what kind of staff is needed in a computation laboratory, because it depends so much on the kind of laboratory and the class of problems of major interest. A good deal will depend on how much the manufacturer helps with programming assistance, although it must be pointed out that canned programs cannot be substituted for a programming staff—the programs are an aid, not a solution. But certainly once a program library is established, the need for a well-qualified staff is diminished in an organization where the kinds of problems remain essentially constant with time. Then the major programming consists of modifying existing programs.

8. Speed

Speed of computing is important only when the computer is unable to keep up with computing demand. It is true that there are certain problems, such as real-time missile problems, where blinding speed may be required before the problem can be solved at all. There are also problems where tight deadlines must be met. But the problems arising from most engineering situations require only that a solution be obtained in a "reasonable" time, usually a few days. It is universally true that when a new computer comes into an organization it is not fully utilized at first. Then, as people become more familiar with it, and as its capabilities become better known, demand increases. Speeds today in the medium-drum machines are comparable with one another, just as are speeds in the big machines. Once again, speed is not easy to define. It is not just multiplication or addition speed, but how the machine is used by the programmer. In considering speed, a prospective user should consider how a computer does a representative problem for him.

9. Reliability

This is the most difficult computer characteristic to assess. No standards for evaluation have ever been set, and the techniques for determining reliability vary widely. There is no common understanding of the meanings of computer operating terms. However, the reliability of all computers is increasing, and the operational records of machines today would have been regarded as phenomenal a few years ago. It is important to notice that the real criterion is the number of correct machine operations per error and that therefore the user must demand more hours between errors in a slow machine than in a fast one. An error every five minutes in a fast machine would be better performance than one every five hours in a machine 100 times slower. One way to look at it is to consider how long it would take to repeat lost work when an error occurs.

The large-scale IBM 704 Electronic Data Processing System, designed primarily for extensive computations, executes most of its highpowered operations at a rate of 40,000 per sec. Purchase price about $1.4 million, monthly rental about $26,000.

Type of machine depends on type of use

The choice of a proper digital computer is not easy and depends upon individual requirements. It is not possible to state a set of criteria that will fit every prospective user's situation. If a man asks for advice on the purchase of an automobile, the adviser would be foolish to make a recommendation without inquiring about the number of children in the family, whether the buyer lives in the city or the country, whether it will be the only car in the family, and how much the buyer can pay down. Each user must evaluate his own requirements and must make some careful cost estimates. Computers are among the most valuable of engineering tools, but like all tools they can be used well or badly, and the people who understand them and use them properly will benefit the most from them.

Three cabinets make up IBM 650 magnetic-drum computer. From left to right are console, power supply unit, and read-punch unit. A part of a fourth unit, the 407 printer, appears at far right. At far left, S. H. Meem, M.ASCE, points to chart held by Harry W. Muller of IBM's Applied Science Division. At far right author Steven J. Fenves, J.M. ASCE, listens to IBM's Mich Pasti.

STEVEN J. FENVES, J.M. ASCE
Instructor in Civil Engineering,
University of Illinois, Urbana, Ill.

Computers shown at ASCE Chicago Convention

An outstanding feature of the 1958 Chicago Convention was the Computer Show staged by four major manufacturers of electronic computers. The show, which ran daily throughout the Convention, attracted wide interest. This was a unique opportunity to observe the computers in operation and to compare their characteristics and performance. The demonstrations consisted of various civil engineering problems, such as earthwork computations, traverse closure, design of reinforced concrete columns, flow distribution in pipe networks, and others.

The computers exhibited are classified as small models in comparison with some of the existing "giants" such as UNIWAC II and the IBM 700 series. However, their small size, reasonable speed and relative ease of programming make them ideally suited for the majority of computations encountered in civil engineering. Addition times vary from 1000 per sec to 20 per sec. To a person not acquainted with computers these may sound like astronomical figures, but even for such a simple problem as earthwork computations, hundreds or even thousands of elementary operations are required to arrive at the net volume of cut or fill between successive stations.

The advantages of digital computers lie, first, in the fact that once a solution for a general problem has been worked out and translated into a program consisting of the steps required to solve the problem, the computer can execute these steps automatically over and over again and solve similar problems with different numerical values. Second, the computer can be made to perform decisions and select its own path, the decisions being based on the results of certain computations. Thus the computer can decide what embankment slope to use or select structural members to satisfy given stresses. Third, the computer can alter its own instructions so as to perform the same operations on different sets of data. In this way only a relatively small number of instructions are required to perform long problems. A self-checking feature incorporated in all four computers is an automatic stop which functions if the result of any computation exceeds the capacity of the computer.

This article will discuss some of the features of the four computers in the show at the Chicago Convention. General characteristics of digital computers are discussed more completely in an article by Dr. John Nash appearing in this issue.

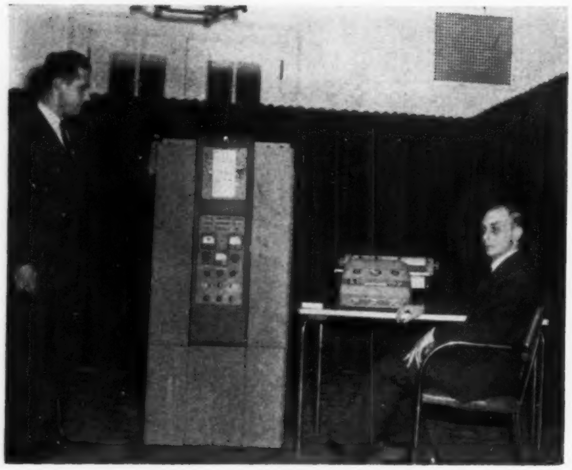
The IBM 650

The IBM Type 650 Magnetic-Drum Data Processing Machine consists of three cabinets: a read-punch unit, a console containing the computer proper, and a power supply unit. An average installation requires about 18 kw of power and 250 sq ft of floor space. Data and instructions are entered on standard punched cards at a rate of 200 cards per min. There is no provision for typing data directly into the computer. The results of computations are punched on cards at the rate of 150 cards per min. A feature of the read-punch unit is a control board which allows the computer to read information arranged in any pattern on the cards and punch the results in any desired format. A tabulating printer is normally used to print the results from the punched cards.

Computations in the 650 are performed in the decimal number system, and are carried to 10 significant digits. Control circuits check each number as it is being transferred from one location to another and stop the computer if an error is detected. The storage, or memory, is a magnetic drum retaining 2000 10-digit words with an average access time to any memory location of 2000 μsec (micro-seconds).

The computer obeys a program consisting of a series of instructions entered at the beginning of each problem. There are about 90 instructions available covering all arithmetic, control and transfer operations. Conditional transfer commands are available which instruct the computer to proceed on different paths depending on whether the result of a certain computation is negative, zero or positive.

Several methods are available for the efficient preparation of programs. In all these the computer essentially takes



Bendix Model G-15D is a general-purpose computer housed in an upright cabinet. Top panel contains photoelectric reader and paper-tape punch. It is here being demonstrated by Harry W. Schultz and Stetson Avery, sales engineers for Bendix.

Desk-size cabinet holds Burroughs Electrodata 101. John Koudela, Jr., sales representative, is removing one of the pin-boards by means of which the instructions are entered into the machine. In left foreground is paper-tape output unit.

over the somewhat tedious "book-keeping" operations required in programming. In certain methods, the computer translates the programmer's mathematical symbols into a program which it can execute at full speed. In some of the other methods the symbols are interpreted one by one and the machine steps necessary to perform the indicated mathematical operation are executed. Thus, "add A and B with their decimal points properly lined up" becomes a single instruction, and the computer performs the required shifting operations before adding. These latter methods sacrifice machine speed, but will produce a finished program in a shorter time.

Excellent features of the 650 are the numerous checks incorporated, the various programming aids, and the flexibility afforded by punched cards.

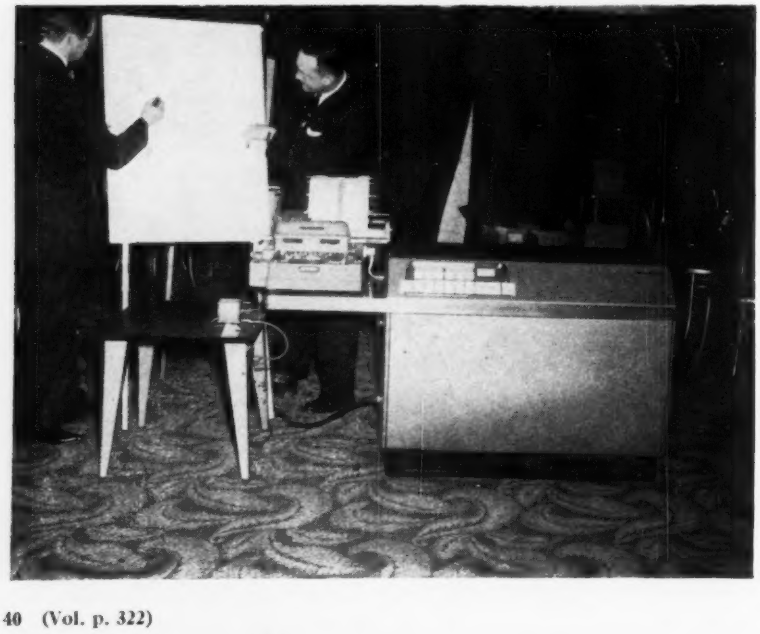
The LGP-30 Royal

The LGP-30 Royal Precision Electronic Computer is a compact machine housed in a desk-size cabinet. It requires 1.5 kw of power and contains its own cooling unit. Input and output are through an electric typewriter mounted on the computer cabinet. This typewriter can also punch and read paper tape at the speed of 10 characters per sec. The computer can be programmed to print results in any format that is desired.

Internal computations are performed in the binary system; that is, all numbers are represented as multiples of powers of 2, rather than the more familiar powers of 10 in the decimal system. However, this does not concern the user since a subroutine automatically converts decimal input into binary numbers, and the final results into decimal numbers. The advantages of using binary numbers are faster operation and less complicated circuitry. The machine uses 30 binary digits per word, which corresponds roughly to eight decimal places. The data and instructions are stored on a magnetic drum capable of holding 4,096 words with an access time of 7,500 μsec.

There are 16 possible commands which the computer can execute. These instruct the computer to add, subtract, multiply or divide, transfer to another part of the program, transfer only if the result of a computation is negative, read, print, store information in the memory, and stop. A cathode-ray tube mounted on the control panel permits visual checking of partial results when the computer is stopped. Instructions can be arranged in such a way that each instruction will be in a position where it can be read exactly at the time

Royal McBee Corporation's versatile LGP-30 computes and records elevations for 1,500 ft of highway profile at 50-ft intervals, including vertical curves, in 6 min. Electric typewriter is recording results. Demonstrating problem is David T. Herman, computer analyst for Royal McBee, left.



when the computer is ready to execute it, so that the computer never has to wait for the next instruction.

The prominent features of the LGP-30 are its small size, extreme simplicity of programming, and the large storage capacity which makes it possible to store several programs in the memory and then call them into operation as required by the nature of the problem to be solved.

The Bendix G-15

The Bendix Model G-15D General Purpose Digital Computer consists of an upright cabinet housing the computer and an electric typewriter. The power requirement is 3.8 kw. Input to the computer is either through the electric typewriter or a photoelectric reader capable of reading 300 characters per sec from prepunched paper tape. Output is either through the typewriter or a mechanical punch handling 17 characters per sec. The advantage of using paper tape for input and output of data is that the tapes can be processed on lower-cost equipment and thus more computer time is available for actual computations. However, the computer itself is a self-contained unit and operates efficiently without any auxiliary equipment.

The internal number system is binary but conversion routines are used to convert from and to decimal numbers as required. The normal machine word consists of 28 binary digits or roughly 7 decimal places, but double precision numbers, consisting of 57 binary digits, can be used with equal ease. The storage capacity is 2160 words with an average access time of 14,500 μsec. Of these locations, 860 are reserved for instructions and the remainder can be used for storage of data.

The standard command list contains 84 commands including arithmetic operations, conditional transfers, and input-output commands. In addition, more experienced programmers can make up about 1300 special commands to suit their particular purposes. Simplified interpretive routines are also available and have been used extensively. In these, every instruction represents many steps that the machine has to go through to perform a given algebraic operation. These routines have the further advantage of automatically keeping track of the magnitude of the numbers, so that the programmer does not have to determine the magnitude of all the numbers during computation and scale them accordingly.

Outstanding features of the G-15D are the availability of the simplified coding procedures, the facility in using double precision numbers, and the ease with which it can be expanded from the basic unit to a central computer in a larger system.

The ElectroData 101

The Burroughs ElectroData 101 Electronic Computer is contained in a desk-size cabinet. The power consumption is 3 kw. Input to the computer is through an 11-column keyboard resembling a desk calculator. An optional punched tape unit is available through which data can be entered into the computer. Output is through a printer which prints a 12-digit number in one operation in any format desired, or through an optional paper-tape punch. The E101 uses 12-digit decimal numbers in all operations. The memory of the computer consists of a magnetic drum capable of retaining 220 12-digit numbers with an average access time of 8500 μsec. The entire memory is available for storing numerical data.

The E101 is externally programmed. Instructions are stored in removable pinboards so that they are visible during the entire program. There is room for 8 pinboards each containing instructions to execute 16 separate steps. The instructions are specified by the locations of the pins in the boards. In executing a program the computer scans the pinboards one line at a time and executes the specified instructions. The computer can also obey instructions read from paper tape, which greatly extends its capacity. There are 46 instructions available to cover arithmetic, control and input-output operations. The computer can also modify its instructions for repetitive operations.

The E101 is designed to solve problems too complex for desk calculators and yet too small for economic solution on large computers. A large proportion of civil engineering problems fall into this category. While it is considerably slower than the other computers exhibited, programming and checking of programs are proportionately easier.

Help available

All the computer manufacturers make available to the users subroutines for the solution of common problems, such as trigonometric functions, solutions of simultaneous equations, and many others. These can be incorporated into programs when required, thus reducing considerably the time spent in preparing new programs. Various subroutines are available for input and output of data and for checking new programs. The manufacturers also provide guidance in setting up computer installations and in the development of programs. In addition, the users of particular computers have formed exchange groups to share computer programs and reduce duplication of programming effort.

The idea of the Computer Show was suggested by Eivind Hognestad, A.M. ASCE, Chairman of the Technical Program Subcommittee of the ASCE Chicago Convention. Arrangements for the show were handled by F. A. Reickert, M. ASCE, a member of the Structural Division's Committee on Electronic Computation.

GLOSSARY OF COMPUTER TERMS

Instruction, order or command: a symbol or code defining an operation, which causes the computer to perform that operation.

Subroutine: a set of instructions directing the computer to carry out a specific mathematical operation.

Program: used in this article to denote the complete set of instructions necessary to solve a given problem. This term is often used to include the complete plan for the solution of a problem, including the numerical analysis, the coded instructions, and specifications for input and output data.

Storage or memory: a device used to retain units of information for future reference.

Address: a label which identifies a location in which information is stored.

Access time: the time interval between the instant at which information is called from storage and the instant at which it is actually available.

Word, or machine word: a set of characters occupying one storage location and treated by the computer as a unit. This can be either a number or an instruction.

Transfer, branch, or jump: an instruction to take the next instruction from an address which does not follow the normal sequence. It can be unconditional or conditional upon the result of previous computations.

An evaluation and a proposal

COMPUTERS in the profession

ELMER K. TIMBY, M. ASCE, Partner, Howard, Needles, Tammen & Bergendoff, Consulting Engineers, New York, N. Y.

Only a decade has passed since the first commercial application of electronic computers. For less than half of that period have computers been used in the field of civil engineering. Nevertheless, a general evaluation of their future effect on the civil engineering profession appears very much in order. While we are fully aware of the excellent efforts of other groups in the application of computers to their problems, we are more familiar with our own experience, which, over a period of two years, has been sufficiently broad to permit generalizations.

The original catch-phrase, "electronic brain," used as a description of electronic computers, is being replaced by phrases like "high-speed robot." This is a healthy change, since a sober recognition of the limitations of these machines is as essential as a realization of their capabilities. If we are both cautious and intelligent in our usage, we will find that it is possible to utilize computers in a selective evaluation capacity, thereby extending applications beyond merely routine calculations. An apparent contradiction appears: although a machine cannot think, it can produce in a design the results of more advanced thinking than has been common in the past on similar work.

Remembering that preparation of a program of instructions for a computer must be done by experienced engineers with superior ability in mathematics, let us consider a few examples. Our horizontal alignment program, consisting of over 14,000 instructions for a double-address medium-size computer, allows us to calculate multi-compound curve geometrics in a matter of two minutes of machine time. We know that, in solving such a problem manually, there are several choices as to the approach to defining the initial geometric parameters and boundary conditions which control the calculation of required answers. The engineer programming this problem for a machine must decide which *one* method of approach is the best, since the computer machine must be supplied with precise instructions involving no more than a two-valued logical choice. Once a problem is coded, the computer will always solve it by this one method. To a limited extent, the ability of the engineer has been transferred to the computer in such form that the machine can make logical choices between a series of two alternate possibilities.

While the computer cannot be creative, it can duplicate certain elements of the thinking, judgment, and experience of the programming engineer. Consider for example the design of roadway superelevation transitions. Here the specifications allow considerable room for judgment on the part of the engineer—on such matters as the exact value of the friction factor, the location of the transition relative to the point of compounding the curve, and the appearance of the transitioned edge. In programming this problem, when the most desirable design involved the solution of a theoretical cubic equation, we did this within the coding which forms the instructions to the machine. Thus the ability of the machine made the use of advanced theory a more routine operation than was economically feasible with manual methods.

The most ambitious undertaking in our office thus far has been the programming for the design of a rigid-frame reinforced-concrete bent. Since a detailed description of this type of problem appears elsewhere in this issue, it will be merely stated here that the degree of creative thinking and practical experience reflected in this program was of a very high order. The machine will in a strict sense, by reflecting the intelligence incorporated in the coding, "think" of a bent precisely as a highly skilled and experienced structural designer would if he had the time to use the most advanced theory.

Before computers were in use, engineering design consisted of 5 percent "glamour" and 95 percent plain hard work. Computing devices can change that ratio to perhaps 50-50. In part this is because a machine can remember in its coded instructions complicated advanced theoretical methods and can make limited logical choices as the solution progresses. To that extent the programming engineer does his thinking once in contrast to the designer who, using manual methods, must repeat it for every structure. Nevertheless, the writer is of the very firm opinion that hard work will never, and indeed should never, be eliminated. No design which comes from machine calculations should be used without careful scrutiny by an experienced designer as to its reasonableness.

Let us survey an engineer's current work using manual methods, with emphasis on the 95 percent of plain hard work. This work falls into two general categories—experienced evaluation and technical production. The first category consists of organizational, procedural, and design decisions, the second of calculation and drafting. In the second category the necessity for repetition from structure to structure has led many engineers to feel that they are required to do subprofessional work.

It is common experience that the effort to be creative, or "glamourous," calls for the expenditure of considerably more energy than does working in a prescribed routine pattern. Since the truly professional engineer welcomes the former kind of effort, and resents the drudgery, we predict that with the advent of machines that can absorb, quantitatively, most of the calculating now performed in engineering offices, the engineer's future work will consist to an increasing extent of or-

Ramps from New Jersey Turnpike to Holland Tunnel were designed with aid of digital computer. Where structures require superelevation of roadways, computation of deck edges is well suited to solution by this means. Resulting edge profiles are theoretically correct and esthetically pleasing since the program develops the ideal cubic equation of a rotating edge.

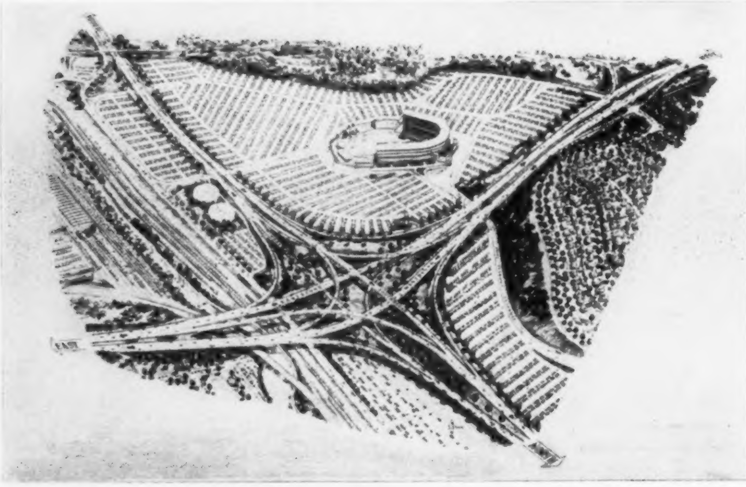
ganizing the job, making design decisions, defining procedures for smooth production, and supervising the completion of computation and drafting by a combination of machines and technical aides. At the same time, the engineer will find himself working more at the drafting board as he develops his concepts. This is good; a well-made drawing transmits much information accurately and concisely.

What, then, will be the nature of the creative design decisions left to the engineer? It has long been a private quip among engineers that the "factor of safety" has, in fact, been a more palatable description of a "factor of ignorance" or a "factor of convenience." In all fairness it must be said that such a factor has been necessary, since refined procedures often were too time consuming, and economic feasibility is always a prime consideration. Since high-speed computers make such complex calculations economical, it now becomes feasible to reexamine the very fundamentals of our design approaches to eliminate many "factors of convenience" and, through research, to reduce the "factors of ignorance." It is in this area that the engineer faces his greatest challenge. Great strides have been made in this direction, particularly at the University of Illinois under Dr. Nathan Newmark, M. ASCE.

At this point, certain aspects of human behavior should be noted. Inertia is a characteristic trait of many people. It is far easier to repeat a procedure because "it has always been done that way" than to initiate new, and possibly strange, approaches. For several valid reasons, such as size of project, lack of a specific reproduction of the prototype, and lag in proving new knowledge, precedent wields a strong influence. It is difficult for any person, accustomed by years of conditioning to certain habits of thinking and to confidence in methods previously applied with satisfactory results, to reexamine in detail his own thought processes. "To remove the rust from the hinges of the mind," as one scientific writer has said, "is far from easy." And yet this is precisely the task the engineer faces in developing electronic methods of computation.

We all recognize the current and short-range benefits of electronic computation. In their justified eagerness to take full advantage of the new tool many have committed themselves to the greater and more difficult goal. That success can be achieved appears certain. Engineers have never failed when called upon to blaze new trails and tame natural forces. They now face a challenging intellectual adventure, but this is no cause for alarm.

We can visualize future engineering staffs as consisting of two rather distinct groups of personnel—engineering scientists and technical engineering aides. This subdivision exists today; the future will only emphasize it. Within the former group will be many levels of creative ability and responsibility, analogous to the gradations that now exist in the profession. The civil engineer's training makes him the logical heir to such future fields as astronautics (an evolution from surveying), design of space structures (an evolution from bridges), rocket ports (an evolution from airports), and space logistics (an evolution from highway and trans-



A group of structures such as the Milwaukee Stadium Interchange includes numerous complexities in compound horizontal alignment, verticle curvature, and superelevated decks well suited for solution by computer. Early in the design phase, proper programming yields detailed data such as pavement elevations, framing dimensions, and depths to flange of steel.

portation planning). In the same way he has moved naturally into airframe design in recent years.

The engineer will never be replaced by the computer. Quite the reverse; the computer, by freeing him from routine labor, now challenges him to grow into the scientific maturity our fast-moving technological society demands. This change in emphasis is somewhat like the difference between scheduling an electrically powered shovel of large capacity, and holding the handles of a horse-drawn scraper.

To the young engineer, desirous of advancing in his profession, one point must be made crystal clear. No engineer in any responsible position should use machines or the results they produce unless he himself can produce readily, by manual methods which he thoroughly understands, the results achieved by the machines. This applies to all phases of his work—geometry, layout for a design, the design itself, layout for a drawing, and the making of the drawing. The machine will eliminate the drudgery of doing the same thing over and over again but it will never eliminate the need for the complete understanding and reasoned judgment which fits the engineer to make decisions and to assume leadership in carrying them out. This aspect is going to be the hardest for the young engineer to master and for his superior to administer. It is predicted that those who fail will be benched.

A suggestion

The intelligent application of electronic computers to the solution of problems in civil engineering takes time and costs money. The present status of application is that certain individuals, firms and agencies have made applications to specific problems. Many cases of duplication have occurred because developers have felt compelled to protect their investment of time and money by retaining the results of their applications for their own use. Such actions, although considered justified, are contrary to the traditional way in which professional knowledge has been advanced, that is, through free interchange and publication of new developments.

Some progress made

Certain agencies, particularly the U.S. Bureau of Public Roads, have made some progress in interchanging applicable programs. Such interchange has also occurred in limited fashion within user groups for certain machines. However, the general and free interchange of the results of applications, so necessary for efficient utilization of existing and future developments, has been incomplete from the point of view of the profession as a whole.

The fundamental requirement for free interchange is that an individual who has had the initiative to make the development in the first place should be equitably reimbursed, by some means of exchange, for the efforts he has expended. Here is a suggestion for accomplishing this.

The various Technical Divisions of the Society have committees on electronic computation. For the purpose at hand the chairmen of the various committees could be combined into an administrative group. This group could be relied upon to receive the results of application—that is, programs and working decks or tapes—and to hold them confidential within their committees until some stated future date, say July 1, 1959. All such information could then be made available simultaneously to the whole profession through some form of publication or through initiation of an added service by the Engineering Societies Library. Such a program could not be truly effective unless practically all available applications were contributed to the pool. It is believed that enough has been written on the subject to permit a good evaluation of what has been accomplished and thus to measure whether or not all parties have contributed their major efforts.

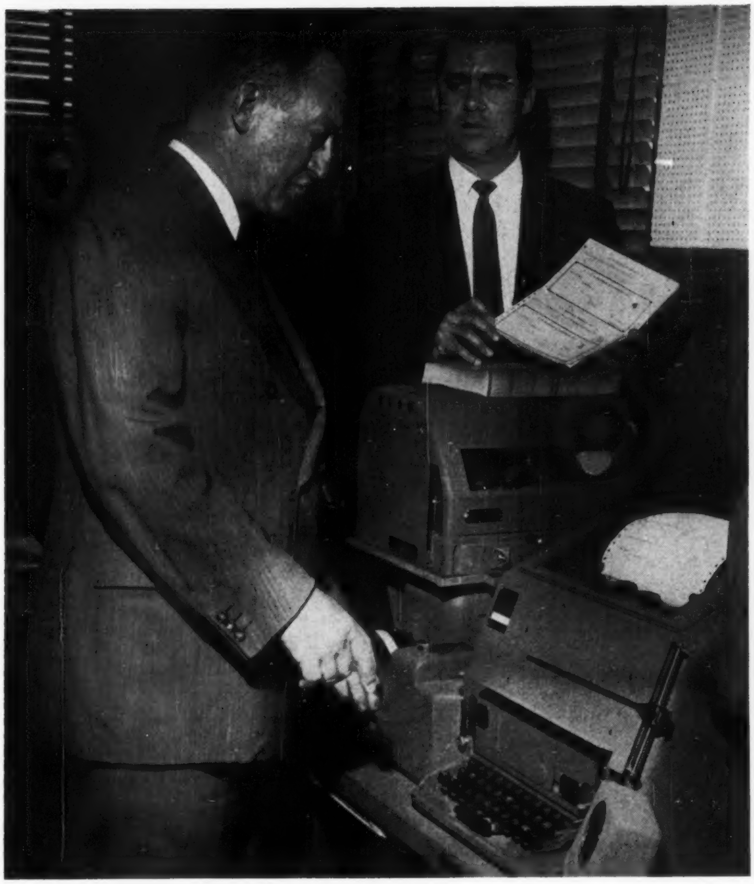
In the meantime, the contributed applications could be evaluated by the administrative group and its committees and their extent and applicability cataloged on a uniform basis. Early publication of such results in concise form could avoid the expenditure of unnecessary efforts in duplicating results. At the same time, to whatever extent possible, problems coded for one type of machine could be translated into programs suitable for other types of machines.

Sharing is an investment

Through such a plan each person, firm or agency that had spent time and money on a particular problem would be repaid amply by having available on July 1, 1959, solutions usable on their own equipment for additional types of problems. Of course, those members of the profession possessed of an extra share of inertia, who had followed the pattern of letting "George" do it, would also benefit. This is inevitable and should not be considered a justifiable reason for not adopting a sound and aggressive procedure.

Only some such plan—and there may be a better one—providing for a free interchange of developments in programming, can enable the profession to utilize all existing computer knowledge. The results of some such plan would be infinitely more valuable if it could be carried out simultaneously for all societies within United Engineering Trustees, and also if it could be made a continuing service associated with the new Engineering Center. To utilize existing knowledge will not only conform to the ethical standards of the profession but also will aid it tremendously in performing its full duty at a time when it is engaged in meeting its greatest challenge.

Clifford Strike, M.ASCE, president of the F. H. McGraw & Company, Inc., confers with Tom Williams, director of McGraw's data processing department, on details of teletype writing of checks at distant job office. A written signature is required so checks are safe from line-tapping and error.



FRANK J. McCLEAN, Vice President (Finance),

F. H. McGraw & Company, Hartford, Conn.

Machines in home office

make payrolls and keep costs for remote jobs

Automatic accounting machines and teletype are teamed to handle payrolls and keep costs on F. H. McGraw & Co.'s construction jobs, regardless of distance from the home office at Hartford, Conn. For most jobs the basic payroll data are transmitted by teletype to the home office, where they are processed. The checks are then written at the remote job by teletypewriter. The same processing of payroll data yields itemized construction costs, which are quickly available to home office and project personnel. On the largest McGraw jobs, separate equipment is installed at the site, so that the project is operated on an autonomous basis.

The payroll is the key to cost keeping as it is the largest variable item. Cost of permanent materials in the project can be determined rather closely, and the approximate cost of the temporary plant for construction is known in advance. The payroll in relation to progress in setting up the plant and in cost per unit of work accomplished, compared to the estimate of expected cost, shows the financial expectancy of the job. While cost keeping comes from the payroll and the material accounting records of the job, it is in no sense a by-product. It is a carefully planned part of the work that fully justifies all expenditures required for its use.

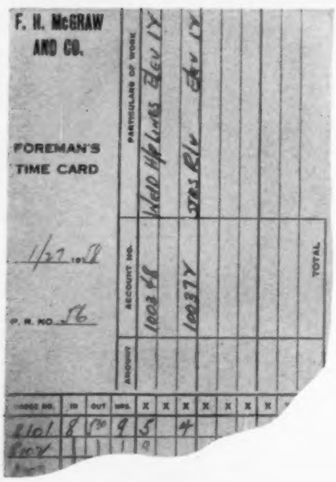
As soon as the company is awarded a job, engineers devise the accounts needed for financial control of the project. For each item in the cost-keeping system a card is set up in the International Business Machine system. These cards, containing job description, account number and estimate, are processed through the IBM 407 accounting machine for automatic printing of the "official estimate and chart of accounts"—a form that is distributed to the principal supervisory personnel concerned with the job.

At the project, every craft foreman gets a time card each morning for recording the usual field time data for each man in the crew. This provides for breakdown of the labor time on each of several classifications. Cards are audited each day and account numbers inserted by the time-keeping staff, under supervision of a cost engineer.

Payroll procedure

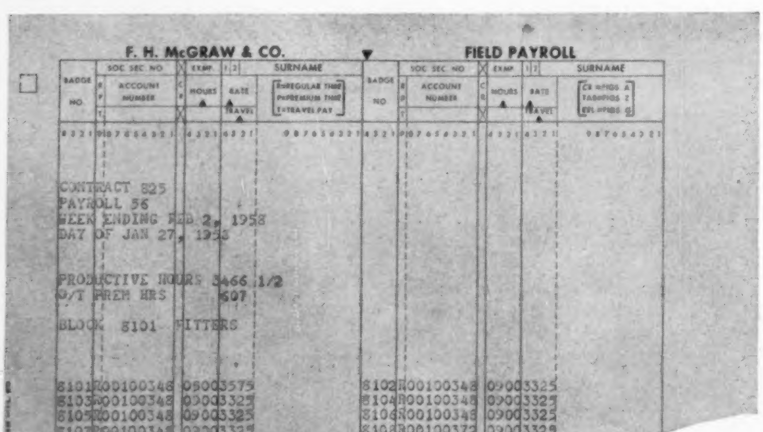
At this point, the payroll is dominant since prompt payment of employees must be assured despite the fact that the payroll is handled at the distant home office. The system used employs both IBM and Bell Telephone equip-

Payroll transmittal and cost-keeping equipmment is seen in home office. At left, perforated tape from teletypewriter is fed into machine that punches pay data on card for calculator.


F. H. McGRAW AND CO.

FOREMAN'S TIME CARD

FIG. 1. On foreman's time card, daily hours worked and distribution of time for each man are recorded. This information is transmitted by teletype daily to home office.


F. H. McGRAW & CO. FIELD PAYROLL

CONTRACT 825
PAYROLL 56
WEEK ENDING FEB 2, 1958
DAY OF JAN 27, 1958

PRODUCTIVE HOURS 3466 1/2
O/T PREM HRS 607

BLOCK 8101 FITTERS

8101R00100348 09003575 8102R00100348 09003325
8103R00100348 09003325 8104R00100348 09003325
8105R00100348 09003325 8106R00100348 09003325
8107R00100348 09003325 8108R00100372 09003329

FIG. 2. Field payroll record is transcribed by teletype, simultaneously with tape transmission, in this form at home office.

ment. At each job location, a Plan 14 Bell Telephone Station is installed. This consists of a Type 14 reperforator, a Type 15 teletypewriter, and a Type 19 teletypewriter. In the Data Processing Center at Hartford, there is a Type 19 teletypewriter for each of the lines employed and the master controls for the system. In addition to the Bell Telephone equipment at the center, the following IBM equipment is employed:

- 407 accounting machines
- 604 calculating punch
- 514 reproducing summary punch
- 046 tape-to-card punch
- 063 card-to-tape punch
- 077 collator
- 082 sorter

Each day at the construction site a "Cost Coded Payroll Source Document" is audited and rated; the productive and premium hours and travel allowances are totaled and controls established. See Fig. 1. These source documents are transcribed on the teletype on the form used in our payroll procedure, Fig. 2. Simultaneous with the preparation of this form, a five-channel paper tape is perforated on the Type 14 reperforator. The page copy (Fig. 2) is audited and, if necessary, a correction tape is prepared for transmittal. A tape of master-card information for new hires is transmitted daily at the end of the daily time report.

The tape is transmitted by teletype over lines leased from A.T.&T. at a rate of 75 words a minute to the processing center at Hartford, where it is received in the form of a five-channel tape, which produces the page copy of Fig. 2. As a control, totals for productive and premium hours and travel allowance are made up for the day and transmitted for use as a check on the items sent. These tapes are transcribed on IBM cards, Fig. 3, using an 046 tape-to-card punch. Data from each job are balanced to controls on the 407

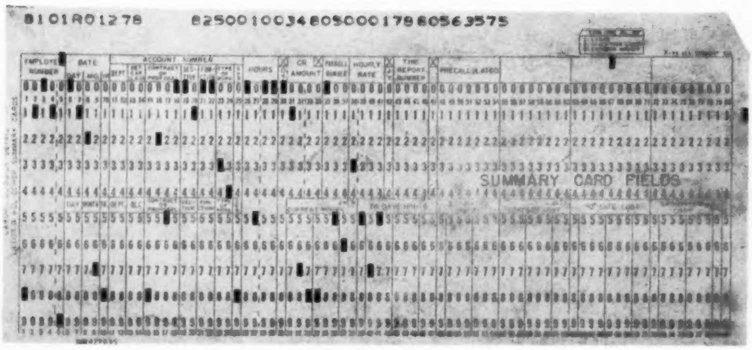


FIG. 3. Totals for productive and premium hours, travel allowances, and account number for the day are transcribed from teletype tape, using an 046 tape-to-card punch.

accounting machine and extended, at 100 calculations a minute, on the 604 calculator. This procedure is repeated daily.

At the end of the payroll week, the daily detail cards are summarized on the 407 accounting machine to obtain weekly pay cards similar to Fig. 3. The summary listing is verified for total productive and premium hours by comparison with the weekly hours control, for each employee, received from the job site via teletype. The audited weekly pay card is calculated on the 604 for taxes, deductions and net; prepayments are deleted and current payees are assigned check numbers.

The payroll register, Fig. 4, is prepared and the cards converted to tape on the 063 card-to-tape punch for transmittal of checks to the job site. The distant job is alerted that checks will be sent. A roll of blank check forms is put in the teletype receiver, which fills out the check form (Fig. 5) completely except for the signature. Checks are totaled at the job site for the net control amount before being signed. Payroll register and subsequent labor distribution sheet are mailed to the job.

This means of handling the payroll eliminates the hiring and training of five to perhaps as many as fifty people in a new area when a job starts. It concentrates the payroll in experienced hands where deviations can be better controlled. McGraw probably is the first to use long-distance transmission of hourly payrolls but the pioneering effort has been worthwhile.

Cost data

Additional data needed for cost determination also are teletyped to the home office for processing. Purchase and commitment details are transmitted to the IBM center with estimates of construction units completed during the current week. Data are put onto punch cards and collated with the labor distribution summary cards. This provides additional summaries to be used in preparing the "weekly labor cost report."

Normally these data are in the hands of engineers and project managers in the field within four days after the close of the pay period, indicating up-to-date costs for each item of the work. This enables job personnel to note any point at which current costs indicate difficulty. The necessary action can then be quickly taken.

In addition to cost keeping, the teletype and accounting machines provide economies in the accounts payable. A due-date file is set up for all accounts, and payments are made to take advantage of all discounts offered. Cash requirements on accounts payable can be closely controlled to keep the money required to a minimum. A more complete revised estimate of costs and job commitments is made up monthly from all data available, for study by top management.

While the operation described is primarily for jobs on which major accounting is done at the home office, the procedure is the same for larger jobs where all work is done at the site. A complete set-up for payroll and accounting is installed at each job. These set-ups are manned by experienced personnel who can be trusted to handle all details. But cost and accounting data are regularly sent to the home office as an overall check.

The advanced business methods described are in line with the company's policy of continually developing new ideas that will result in advantages to clients. Undoubtedly the new developments have contributed substantially to the growth of the company, which since its start in 1929 has completed more than 2 billion dollars worth of heavy and industrial construction and engineering projects in major countries throughout the world.

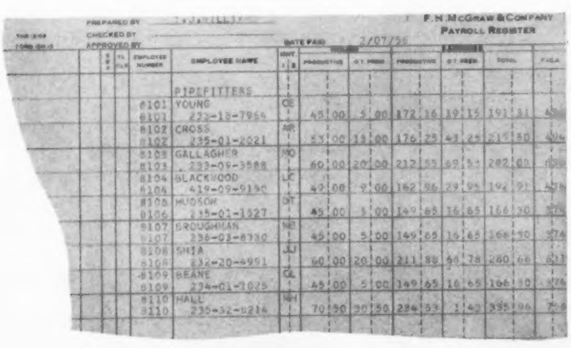


FIG. 4. Payroll register data, shown at left, are converted to tape for transmittal to checks at job site.

FIG. 5 Check is automatically completed by teletypewriter, except for signature.

S. E. RIDGE, M. ASCE, Assistant Chief, Division of Development, Office of Operations, Bureau of

Use of electronic digital computers in

The digital computer, as the name implies, is a device for the making of calculations in digital form. It can do nothing more than an ordinary desk calculator in so far as computation is concerned. However its computations are performed at a fantastic rate of speed. This speed, together with its capacity to store a multitude of intermediate results for use in later calculations, and its ability to alter its course according to the intermediate results obtained, is what makes the digital computer so valuable for engineering calculations. The digital computer has, therefore, four important characteristics:

1. It can perform involved computations at a very high rate of speed.
2. It can be programed to follow a very long and involved series of computations.
3. It can store the results of each separate computation for use in a later step.
4. It can make a comparison of intermediate results with predetermined quantities or with other intermediate results and alter its course of action or program accordingly.

Our investigation of the use of electronic computers in highway engineering has shown that many of our operations can be performed equally well or perhaps even better on an analog computer built and operated specifically for each operation. However it is more economical to perform the operations on the digital computer because of its versatility. One possible exception to this rule is in the field of traffic analysis. There is a strong indication that here an analog device would be appropriate.

Some 40 state highway departments and 25 of our leading highway engineering consultants have, or soon will have, electronic digital computers in operation. This five-million-dollar aggregation of equipment cannot however accomplish its purpose until the programs for its use have been written. This is a most important phase of the work.

Basically a "program" for an electronic computer is simply a series of instructions listing in detail the computations required to solve the problem in question. The program can be written in English, that is, as we say, in "universal" language; or it can be written in the language of a particular computer. Usually it is first written in universal language—in English or in mathematical terms—and later translated or coded for the computer.

Universal program form

In the universal form it is of value to anyone who has a computer because he can code it for the computer he is using. This is the form in which the program library of the Bureau of Public Roads will be kept. In the coded form the program is of greater value to those who are using the same make of computer for they can use it without going through the coding procedure. This is the form in which the Bendix user group, the IBM share group, and other user groups keep their programs.

To be of value, a program must be such that it will solve the problem in any of its forms. It is not economical to write a program that covers only one set of circumstances and then to find, when you come to use it, that your data cover a different set of circumstances. The programs should also include all the problem decisions that are based on fact. In addition, any series of programs on the same problem should be set up in such a way that the output from one program can be used as input for the next program without the necessity of repunching cards or tape.

To date, programs have been written for almost all phases of highway engineering. In some cases these are available in universal language but more often they are available only in coded form. At the present time seven different computers—the Bendix G-15, the IBM 604, the IBM 650, the Univac 120, the Royal McBee LGP-30, the Datatron, and the Burroughs E101—are in use in highway engineering. In addition the IBM 705 and the large Univac have been used for highway engineering problems. The programs have therefore been written in nine different languages.

As a service to the highway engineering profession, the Bureau of Public Roads intends to translate most of these programs into the universal language. Within a year at least a hundred programs should be available. A list of programs now available can be obtained from the Bureau of Public Roads, Washington, D. C.

The universal form as we envisage it will consist of the following:

1. An exact definition of the problem to be solved, including a sketch where appropriate.
2. Input data in the form required by the program.
3. Output format.
4. A block diagram or flow chart in sufficient detail so that the problem can be coded by someone not familiar with the problem.
5. A detailed description of the method of solution following the sequence of steps given in the block diagram and including the basic equations involved.
6. Exact definition of subroutines, if used.
7. Precise definition of all terms, symbols, and abbreviations.
8. A sample solution developed step by step in conformity with the block diagram, including sketches if appropriate.
9. A clear statement of specifications, number of decimal places to be used, and maximum number of significant figures.

Many of these programs are available for a particular machine through the user group. The user groups also can do much in the way of program

highway engineering

Desk sized and mobile, the LGP-30 of Royal McBee Corp. operates from conventional wall outlet, requires no special installation. Magnetic drum memory holds 4,096 words.

development. Users of the same machine speak the same dialect and can meet together and discuss the programs they have developed in a common language. Through such discussions, a user can often take another user's card or tape program and use it in whole or in part for his own work without developing a full program writeup. To date programs have been written for work in almost all the fields of highway engineering. Some of these are of course suitable for other fields of civil engineering as well.

Survey computations

In the field of survey computations, the first phase of highway construction, programs are available for computing unknown lengths and bearings, determining error of closure, adjusting traverses, computing coordinates, converting coordinates from one system to another, and computing areas of closed traverses. These operations are particularly important to the highway engineer just now, when he is so heavily involved in land acquisition and preliminary location work.

In California, one of the first states to adopt electronic computation for this type of work, over 2,000 courses are being processed each day. Computations for the entire state are performed in the central office, to which the survey data are mailed. There they are processed and mailed back to the districts on the same day they are received. The time required for computation, including preparation of computer input, is only 20 percent of that formerly required by manual methods. The cost is about 40 percent of that by hand methods.

Integration of the electronic computer into the highway location and design process is most interesting. The first phase of this process is of course route reconnaissance, which in most cases can be accomplished by the inspection of existing maps or photography. If not, additional small-scale photography will usually supply the information needed.

It is in the second phase, the preliminary location phase, that electronic computation enters the picture. The highway engineer usually obtains a contour map at 200 or 250 ft to the inch, covering a width of a little over a mile on the selected route or routes. With this information, he visually selects what appears to be the most suitable line and grade and obtains cross-section data on that line. He then uses the computer to obtain the elevation of the highway centerline at each point for which he has a cross section of the actual ground. The computer input for this operation consists of: (1) the starting elevation,

Typical installation of new Bendix G-15 general-purpose computer includes control typewriter. Model G-15 general-purpose digital computer is at left. Two MTA-2 magnetic tape units at right expand storage capacity of the basic computer by 600,000 words. Read-write speed is 430 characters per sec.

Reproduction of material in graph form is accomplished by the Dataplotter of Electronic Associates, Inc. It converts digital point data to accurate continuous-line form, can be operated by a competent secretary.

(2) the stations at grade changes, (3) the plus or minus grades, and (4) the vertical-curve data. The computer then determines the elevation of the centerline grade at each point where a ground cross-section is available.

With the centerline elevation of the trial line established at each cross-section location, the design earthwork program is used to obtain earthwork quantities. The input for this calculation consists of the ground cross-sections, the computed elevation of the centerline grade, the template of the road to be constructed, and the superelevation data. The output consists of the cut and/or fill at each cross section, the cut or fill adjusted for shrinkage or swell at each cross section, and the cumulative cut or fill balance at each station. With this information the engineer decides what changes are necessary in his trial line and grade, and the operation is repeated using the new grade data and the offsets of the new trial line from the line on which the cross sections were taken.

Methods and procedures have been developed by which cross-section data can be electronically punched onto cards or tape directly from the photogrammetric instruments. This eliminates the necessity of reading the information out in visual English and then converting it into computer input by manually punching it on cards or tape.

Also, a program is being developed that will include not only the earthwork quantities and the cost of moving the earth but also such items as the cost of the base and subbase required, the cost of the structures involved, the cost of vehicle operation over the completed facility and the like. With such information available at this stage, the engineer will be able to make a much better determination of the economics of the trial line locations and grades.

Next, a planimetric map to a much larger scale—usually 40 or 50 ft to the inch—and more exact cross sections are obtained on the preliminary line location. For difficult areas and areas where structures are contemplated, a large-scale contour map is also drawn.

With this information the process used for the preliminary location is repeated but with the advantage of far greater accuracy. At this stage the real advantage of the electronic computer becomes evident. The engineer can program the computer to vary the width of the roadway depending on the height of fill encountered, to vary the slope of the cut or fill depending on its depth or height, and in fact to vary any dimension of the road design template that is dependent on exact measurements rather than on engineering judgment.

After the exact location has been established by several trials, the machine design is inspected by the engineer. Any parts of it that are not consistent with good practice, such as undue variations in cut or fill slopes or improper ditch grades, are corrected. With these changes the program is again run through. The output, consisting of the cut or fill at each section, the adjusted cut or fill at each section, the cumulative total adjusted cut or fill, and the slope stake data, is printed out. These data are then photographically reproduced and become a part of the contract documents.

You will note that in the description of this process no mention was made of cross-section drawings. There was no need for them as far as the calculations were concerned. However some engineers and contractors feel that they need at least a few cross-section drawings for purposes of information. This problem has been

solved quite successfully by the development of line plotters by at least two manufacturers. These devices will take the ground cross-section information used in the calculations, and the final cross-section data developed in the computer, and electronically translate them into complete cross-section drawings.

Another development under way in connection with the location and design process is the use of a digital model of the terrain rather than the centerline cross sections for earthwork determinations. The digital model is in essence a cross section except that it is based on a coordinate baseline rather than on a proposed centerline. The proposed centerline can be at any angle to the coordinate baseline. The computer program is written to compute earthwork quantities from coordinate cross sections that are not at right angles to the proposed centerlines. This allows the engineer greater freedom in moving his proposed centerline since it is unnecessary to prepare additional cross sections on the new centerline.

It is estimated that the grade computation can be accomplished in about one quarter of the time required by manual methods. Earthwork computations can be accomplished in 5 to 10 percent of the time needed for manual methods and at 20 to 25 percent of their cost.

Structural design

One of the first uses of the electronic digital computer in the structural field was to determine erection stresses. The American Bridge Company first investigated this use and is now employing the computer as a standard procedure.

In the field of bridge geometrics, several programs have been prepared. Programs are available for determining all the geometrics of multispan skewed bridges on superelevated curved alinements and on vertical curves, with bents either parallel or not parallel. The computer produces chord distances between the intersections of the concentric arcs with the bent-cap centerlines, distances between the concentric arcs measured along the centerline of each bent cap, centerline grade elevations, the slope of each beam, and the middle ordinates of the concentric arcs at the mid point of each span. Other geometric programs produce deck elevations on the basis of a 1-ft grid.

Among the design programs now in use are those for the design of continuous steel-beam bridges of three to five equal or unequal spans. The input consists of the number of spans, span lengths and beam spacing, allowable stresses, and loads. The output consists of the maximum moments and shears, the size of the beam required, and the number, sizes, and lengths of the flange plates required. The complete computation, covering both interior and exterior beams, requires about ten minutes.

Other programs have been worked out for computing influence-line ordinates for continuous beams; beam deflections; analysis of reinforced concrete columns subject to axial load and either one-way or two-way bending; design of cantilever retaining walls; design of composite beams; determination of design constants for beams of variable moments of inertia; design of reinforced concrete framed bents; analysis of a tied arch; design of reinforced concrete continuous slab and girder bridges; and computation of the torsional resistance of suspension-bridge towers. Equations involving 20 unknowns can be solved in about 10 minutes on a medium-sized electronic computer. This is particularly important in statically indeterminate design. In many cases these programs include the tabulation of material quantities.

Other applications

For a number of years punched-card processing and tabulating equipment has been used in the analysis of the large masses of data involved in highway planning studies. The electronic computer provides a means of further facilitating and greatly expediting the handling of these data and of increasing the quality of route planning through more thorough analysis than was feasible with conventional punched-card equipment. In a number of states programs are being developed to perform such studies on electronic computers.

The use of electronic computers in the solution of hydrology and hydraulic problems involved in highway engineering is being explored. One type of problem being investigated involves the multiple correlation of hydrologic data in estimating peak rates of runoff from a watershed for selected rainfall frequencies. A second type of problem adaptable to solution on electronic computers involves the determination of the economics of different sizes and shapes of bridge openings and clearances. Urban runoff and urban storm sewer design problems are particularly adaptable.

A program has been developed for extending, analyzing, and tabulating bid data at contract lettings. Several states have developed other programs for computing acreage of clearing, grubbing and sodding, and for computing borrow-pit excavation.

Electronic computers are to be used on the current AASHO Road Test to process and analyze the tremendous mass of data developed during the course of the test. If such computers were not used, it is estimated that ten to fifteen years would be required to analyze the millions of pieces of data and to prepare the final report. Data from electronic detecting devices will be recorded in a form that can be used directly as computer input, or in some cases, in a form that can be electronically converted into an acceptable input form.

The speed with which a state or other engineering organization can build up its computer work load to an economic level is illustrated by the fact that Nebraska, which installed an electronic computer in February of 1957, built up its work load to about 260 hours per month by September of 1957. The programming for this work was performed at a cost of about $18,000 in payroll costs and $12,000 in machine time.

This new tool is so fast that it is now possible, on much of our engineering work, to use the original theory and formulas instead of the approximations now generally used to save time. Thus the electronic computer should improve the quality, as well as the speed, of highway engineering work.

In highway engineering, electronic computation is expected to have five important effects. It will:

1. Speed up and improve productivity.
2. Reduce the cost of engineering work.
3. Reduce the cost of construction by improving the quality of the engineering work.
4. Reduce the cost of highway transportation by enabling the engineer to design a better and a safer highway.
5. Raise the dignity of the highway engineering profession by relieving the highway engineer of much of the tedious and time-consuming computation work load.

The highway engineer has made a good start in adapting this new computation tool to his work. Even though much more remains to be done, he can justly feel proud of his accomplishments to date.

(This article is based on the paper presented by Mr. Ridge at the Kansas City Highway Conference held in Kansas City, Mo., in November 1957, by the Kansas City Section of ASCE.)

Solving spiral bridge

Among the many problems confronting engineers in the design of highway interchanges and other structures is the basic geometric problem of the intersection of a straight line with a spiral curve. The size and lengths of the beams required must be predetermined. Solutions to such problems have been obtained in the past by the use of handbook tables empirically obtained. The availability of modern high-speed digital computers provides a new approach to the problem. No longer is it necessary to avoid methods which require many arithmetic operations for it is easier to program computers to evaluate such mathematical formulations than to search through voluminous empirically determined tables. Mathematical representations of the geometric configurations of spiral bridge structures are here presented, since spirals represent a difficult problem.

A typical bridge design is illustrated in Fig. 1; it consists of a baseline, c, and a number of parallel lines, a, b, d, e, and supporting piers, l_1, l_2, l_3, and l_4. (The piers are not necessarily parallel.) The bridge can begin as a straight line at point A, go into a spiral at B, and continue to C, where it would become an arc of a circle. The roadway is symmetrical around point D with primes indicating points of symmetry for the second half. The problem then is to determine the points of intersection of the piers with each of the parallel spirals and to determine the distances from each of these points of intersection to its adjacent points both along the pier lines and along the spirals. It is also desirable to determine the station of each point on the baseline spiral of the bridge structure.

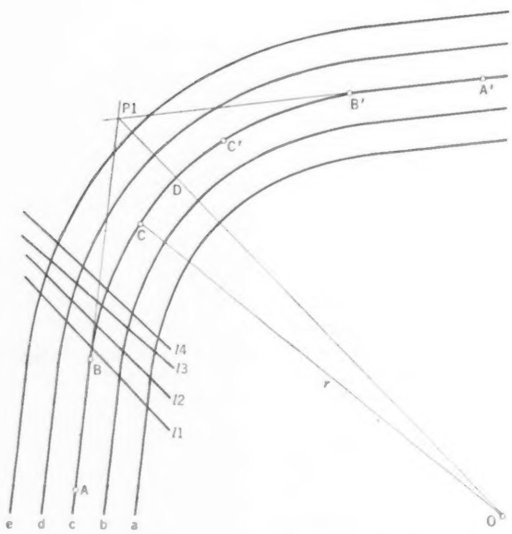


FIG. 1. In typical bridge problem, solved here, structure begins as a straight line at "A," goes into a spiral at "B," and becomes arc of a circle at "C."

In the mathematical model suggested here, the baseline spiral is oriented in a cartesian set of coordinates, appearing in the first quadrant tangent to the x-axis, with its point of origin B at (0,0), Fig. 2. Usually the problem is presented with its own set of coordinates based on an orientation of a surveyor's station. However, a simple mathematical rotation and translation of coordinates resolves this problem.

The spiral represented here is a transition curve between a straight line and a circle and provides a continuous change in curvature from zero to the curvature of a circle. Since the length of the spiral is usually known, an equation representing the spiral in terms of its length is desirable. Consideration of these requirements has led to the choice of Eq. 1, which proves to be the simplest equation satisfying these requirements. (See Fig. 2.)

$$y = Ks^3 \quad . \; . \; . \; . \; . \quad (1)$$

where s is the distance along the spiral from the origin to any point P on the spiral, and K is a constant to be determined.

In Fig. 2, B is the point at which the straight line ends and the spiral begins, and C is the point at which the spiral ends and the circle begins.

$OC = R$; $CF = \Delta R$; $BC = L$; and $BP = S$.

$$\frac{dy}{ds} = 3Ks^2$$

$$\frac{dx}{ds} = \sqrt{1 - \left(\frac{dy}{ds}\right)^2} = \sqrt{1 - 9K^2s^4}$$

Now, at the point where $s = L$, where L is the total length of the spiral,

$$\frac{1}{R} = \frac{d\alpha}{ds} = \frac{d}{ds}\left(\tan^{-1}\frac{dy}{dx}\right)$$

$$= x'y'' - y'x''$$

where primes indicate differentiation with respect to s:

$$\frac{1}{R} = 6\,Ks\,\sqrt{1 - 9K^2s^4} \; +$$

$$3\,Ks^2\frac{18\,K^2s^3}{\sqrt{1 - 9K^2s^4}}$$

Hence, $$\frac{1}{R} = \frac{6Ks}{\sqrt{1 - 9K^2s^4}}$$

$$K^2 = \frac{1}{9s(s^2 + 4R^2)} = \frac{1}{9L^2(L^2 + 4R^2)}$$

Therefore, $$y = \frac{s^3}{3L^2}\sin\alpha \qquad (2)$$

where $$\sin^2\alpha = \frac{L^2}{L^2 + 4\,R^2}$$

$$x = \int_0^s \frac{s^4}{1 - L^2(L^2 + 4R^2)}\,ds \qquad (2b)$$

geometrics by computer

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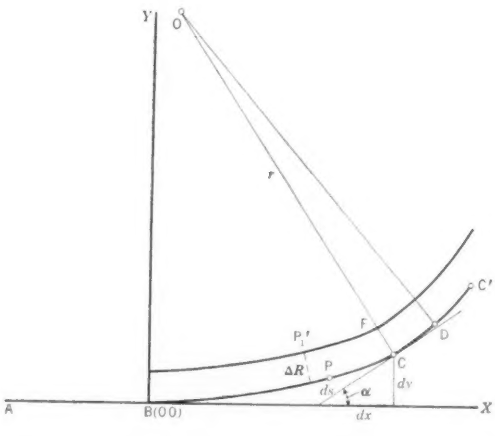

FIG. 2. In mathematical model, baseline spiral is oriented in a cartesian set of coordinates. Spiral is a transition curve providing continuous change in curvature from zero to that of a circle. Simplest equation representing the spiral in terms of its length (usually known) is Eq. 1, $y = Ks^3$.

Equations (2) and (2*b*) are the parametric equations of the curve giving x and y in terms of s. The integral representing x can be approximated by a series,

$$x = s\left[1 - \frac{1}{10}\left(\frac{s}{L}\right)^4 \sin^2\alpha - \frac{1}{72}\left(\frac{s}{L}\right)^8 \sin^2\alpha \ldots\right] \qquad (3)$$

For purposes of computation, this series can be truncated after two terms without losing any significant accuracy.

If ΔR is the incremental distance from the baseline spiral to another parallel spiral, then the equations representing the parallel spiral are:

$$y = \frac{s^3}{3L^2}\sin\alpha - \Delta R\sqrt{1 - \left(\frac{s}{L}\right)^4 \sin^2\alpha}$$

or

$$y = \frac{s^3}{3L^2}\sin\alpha - \Delta R\left[1 - \frac{1}{2}\left(\frac{s}{L}\right)^4 \sin^2\alpha \ldots\right] \qquad (4)$$

$$x = s\left[1 - \frac{1}{10}\left(\frac{s}{L}\right)^4 \sin^2\alpha \ldots\right] + \Delta R\left(\frac{s}{L}\right)^2 \sin\alpha \qquad (5)$$

where s is still the arc length along the baseline spiral from its origin, B, to the foot of the perpendicular from P'_1 to the baseline. When $\Delta R = 0$, Eqs. 4 and 5 are reduced to Eqs. 2 and 3.

The pier lines are oriented by giving the coordinates of two extreme points of each pier line (x_1y_1) and (x_2y_2). The equation for the line will be

$$(y_2 - y_1) = m(x_2 - x_1) \quad . \; . \quad (6)$$

With Eqs. 4 and 5 representing the spiral and Eq. 6 the straight line, we should be able to solve for points of intersection. In attempting to do so we obtain from Eqs. 4, 5, and 6:

$$s = s^2\frac{(\Delta R \sin\alpha)}{(L^2)} + s^3\frac{(\sin\alpha)}{(3L^2m)} + s^4\frac{(\Delta R \sin^2\alpha)}{(2L^4m)} + s^5\frac{(\sin^2\alpha)}{(10L^4)} - \frac{\Delta R}{m} - \frac{y}{m} + x_1 \qquad (7)$$

which is a polynomial equation of high degree and does not lend itself readily to direct solution. In our method the solution is obtained iteratively by substituting an approximate value for s in the right side of Eq. 7 and obtaining a new value which is again inserted in the equation. This process converges rapidly to a value of s which no longer changes from iteration to iteration, and which therefore is the solution to Eq. 7. By substituting this value of s in Eqs. 4 and 5, the coordinates of the intersection of the spiral with a straight line are obtained. This is done for the entire network beginning with the first pier line and finding the intersection with it and all parallel spirals, then proceeding to the next pier line, and so on until the last one. As each point is determined, its adjacent distances to the previously computed points are obtained by the equation

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \qquad (8)$$

where x_1, y_1 are coordinates of points of intersection. Thus s, the solution to Eq. 7, previously described, is the station on the baseline spiral of the point of intersection in question.

Program described

This program was written for the IBM Type 650 computer using an interpretive routine developed at the Bell Telephone Laboratories. It is described fully in the IBM Technical Newsletter No. 11.

The program takes into consideration the fact that a complete bridge design can include a straight line, spiral, and circle, or any combination of the three for a complete bridge span. To make this a general program and to assure its flexibility, three separate subprograms have been written. One obtains the geometrics of straight-line intersections; another, of circle and straight-line intersections; and the third, spiral and straight-line intersections. Each of the

Geometric problems like those explained by Mr. Belzer were solved at Batelle by IBM 650 Data Processing equipment similar to that shown here.

subprograms can be arranged to follow each other in any desired sequence provided the input for each follows its own subprogram. This means that the information defining any section of the bridge must follow the subprogram which was written for that specific part of the structure. The geometrics of circular and straight-line structures are elementary. However, for completeness, a brief description of the three subprograms as they operate in conjunction with the main program of this article are provided below.

Straight-line bridge program

In this program the following input data must be supplied to define the problem:

Item 1. The coordinates, (x_1, y_1) of a reference station point on the baseline.

Item 2. Coordinates of one other point on the baseline of the bridge, (x_2, y_2).

Item 3. Distances from the baseline to all lines parallel to it, (ΔR).

Item 4. Coordinates of two points on one of the piers, assuming that the piers are parallel, (x_{p1}, y_{p1}), (x_{p2}, y_{p2}).

Item 5. Distances from the pier defined by input Item 4 to all other pier lines, (ΔP).

The program will yield the following output:

Item 1. Identification of pier line and bridge line

Item 2. Coordinates of the point of intersection

Item 3. Distance to the adjacent point on the bridge line previously computed

Item 4. Distance to the adjacent point on the pier line previously determined

Item 5. The station corresponding to the point of intersection

To obtain the above results as required in this program, the following equations are solved. The equation for the baseline of the bridge is:

$$y - y_1 = m(x - x_1) \qquad (10)$$

where $$m = \frac{y_2 - y_1}{x_2 - x_1} = \tan\theta \qquad (11)$$

For any line parallel to the baseline, the slope will remain the same, and the coordinates, x_1, y_1, will be replaced respectively by

$$(x_1 + \Delta R \sin\theta) \text{ and } (y_1 + \Delta R \cos\theta)$$

The straight-line equations for the piers are found in exactly the same manner as those for the straight-line bridge described above. The coordinates of their intersections are determined from both sets of equations. The distances between any two sets of points are found from Eq. 7.

Circular bridge

In this program the following information defining the bridge is required as input:

Item 1. Radius of baseline circle (R)

Item 2. Radial distances from the baseline circle to the concentric circles (R_i)

Item 3. Coordinates of the center of the circles (x_0, y_0)

Item 4. Coordinates of two points on each pier line intersecting the circles. (In this case the piers are not necessarily parallel to each other.)

This program will yield the same results as in the previous case. It will, however, solve a somewhat different set of equations.

The equation defining a circle is

$$(x - x_0)^2 + (y - y_0)^2 = R^2 \qquad (11)$$

and that defining a straight line is

$$(y - y_1) = m(x - x_1) \qquad (12)$$

where the slope of the line is

$$m = \frac{y_2 - y_1}{x_2 - x_1} \qquad (13)$$

By solving Eqs. 11 and 12, the coordinates of the point of intersection (x,y) are obtained. The distances between any two points are defined by Eq. 7, from which distances to the adjacent points both along the circle and along the pier are obtained.

Spiral bridge

The input for this program will be as follows (Fig. 2):

Item 1. Length of spiral on baseline spiral (L)

Item 2. Radius to point of greatest curvature (R)

Item 3. Tangent line defined by two points, one of which is at B

Item 4. Distances from baseline spiral to other parallel spirals (ΔR_i)

Item 5. Coordinates of two points on each pier line. (The piers do not have to be parallel.)

The same results as described in the preceding programs will be the output from this program.

The writer wishes to acknowledge the appreciable contribution by Mrs. Diana Ehlers, who provided the greater part of the computer programming as well as some useful suggestions for obtaining numerical solutions. The writer also wishes to acknowledge with thanks the comments and suggestions by Harry Lundstrom of Burgess and Niple, consulting engineers of Columbus, Ohio, in reviewing this article.

Computations like those described in this article are being performed on the equipment shown here, located in the consultant's New York office.

Bridge piers designed by computer

E. M. CHAFETS, A.M. ASCE, and ELI PLAXE, A.M. ASCE

Senior Engineers, Howard, Needles, Tammen & Bergendoff, N. Y.

In determining whether or not a particular problem should be adapted to electronic computation, two important criteria are that the problem be repetitive in nature, and that its solution require an extensive amount of calculation. The design of a rigid-frame pier satisfies both criteria. Reinforced concrete rigid-frame piers are frequently used between the abutments of a bridge or viaduct, to provide intermediate supports for the superstructure, and certainly the calculations required in the design of such a pier are lengthy and tedious.

A typical pier is shown in Fig. 1. Among the forces transmitted to the structure by the stringers or girders supported on the cap are those resulting from:

1. Live load of vehicles traveling on the bridge deck
2. Dead load of the superstructure
3. Wind acting on superstructure and on live load
4. Traction
5. Friction
6. Centrifugal force (for curved roadways)

In addition, the pier itself is subjected to forces caused by temperature changes, shrinkage, wind, and its own dead weight.

As with any hyperstatic structure, an assumption as to the geometry of the pier, including the cross-sectional dimensions, is a prerequisite for design. Moments and forces due to the applied loads must then be determined at sections in the cap and columns. After the selection of critical design values of moments and forces, stresses are calculated, and the assumed pier dimensions are either verified or modified.

Recognizing the difficulties that

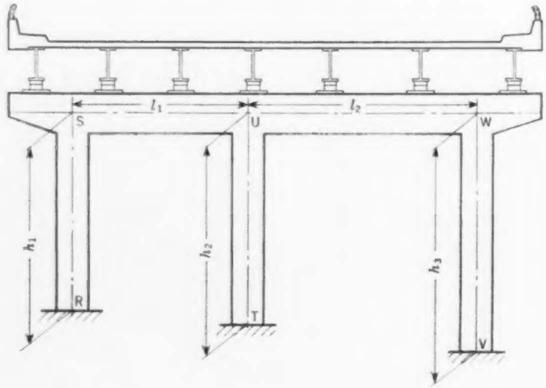

FIG. 1. Design of typical rigid-frame pier is easily done with aid of a digital computer.

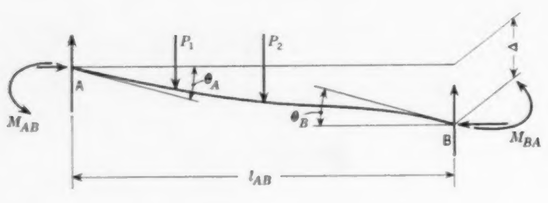

FIG. 2. Slope deflection equations for bending moments at ends of member AB in a frame are solved by computer.

would arise in attempting to program the complete design for a rigid-frame pier, and desiring that the end result should be a totally automatic machine solution, Charles H. Clarahan, Jr., M.ASCE, our chief designer, decided to accomplish the actual coding of the problem in two phases.

Phase I, described in this article, is complete and in operation. It permits the analysis of a pier having members of constant cross section, for force systems acting in the plane of the pier. Structures with two to five columns, supporting a total of 20 stringers on the cap, are included. Either fixed or pinned connections may be specified at the bases of the columns. The cap may be cantilevered beyond the outside columns at one or both ends of the pier. The output of the Phase I program consists of moments and forces, and combinations of moments and forces, at sections in the cap and columns.

Phase II, when completed, will utilize the output of Phase I, plus data obtained for loads normal to the plane of the pier, to compute steel and concrete stresses at various sections in the frame.

Method of solution

To use the computer most effectively in solving a problem, careful consideration must be given to the selection of the fundamental method of structural analysis to be incorporated in the program. The approach followed by an engineer in designing a pier may be based on one of the following:

1. The column analogy concept
2. A direct application of a work principle, for example virtual work
3. The elastic center concept
4. Moment distribution
5. Slope deflection

Column analogy is limited to two column piers. Virtual work and elastic center applications require the setting up of cumbersome equations for piers which have more than two columns. Either the moment distribution or the slope deflection method might be used for the range of structures and loading conditions desired in the program. We chose slope deflection for computer application because the programming logic and coding involved was deemed simpler than that required for the moment distribution method. The solution of the simultaneous equations required by slope deflection is accomplished by the computer in a matter of seconds, and the method of formulating these equations lends itself readily to a simple repetitive process. The analysis is conveniently accomplished with full theoretical rigor and accuracy.

The slope deflection equations for the bending moments at the ends of a member AB in a frame (**Fig. 2**), are Eqs. 1 and 2 in the accompanying box. Here

M^F_{AB}, M^F_{BA} = fixed end moments at A and B due to external loads acting on member AB

θ_A, θ_B = rotations of joints at ends of member AB

Δ = relative translation of joints at ends of the member

K_{AB}, r_{AB} = stiffness and carryover factors for member AB at end A

K_{BA}, r_{BA} = stiffness and carryover factors for member AB at end B

M_{AB}, M_{BA} = bending moments exerted on member AB by the joints at A and B

It follows therefore that calculating the fixed end moments and the values of θ and Δ will enable us to determine the values of the bending moments at the ends of each frame member.

Input to progrgam

The input to the program consists of the design data that would normally have to be specified before a structural designer would be able to proceed with the analysis of the pier. All the frame dimensions must be furnished, along with the total number of columns in the structure, the total number and the locations of the stringers supported on the cap and the moment of inertia of each of the members in the frame. All lateral distances are referenced to an origin at the left of the pier.

In addition, each loading condition for which the structure is to be analyzed must be described, the manner of definition depending upon the particular loading condition. For example, the input data required by the program in order to compute the moments and the forces caused by a change in temperature consist of the coefficient of thermal expansion, the modulus of elasticity of the frame material and the change in temperature.

Furnishing the stringer loads accounts for the effect of the dead load of the superstructure. For live load, the program will determine the moments and forces in the pier, given the location of the left wheel of the axle, the axle width, the force at the pier caused by the wheel loads in a single lane, and the number of lanes. A maximum of twelve live-load positions may be processed simultaneously.

Since wind will act both on the pier and on the superstructure simultaneously, several forces must appear in the input data for each wind-load condition. The forces include the uniformly distributed wind-load acting on the columns, a horizontal concentrated sidesway force acting on the cap, and

Rigid-frame pier supports crossing of Maine Turnpike over U. S. Route 1. This is the type of pier that can be designed by methods described in this article.

the vertical wind forces acting on the cap. In all, a total of 19 loading conditions may be entered as input to the program.

Sequence of solution

The procedure followed by the program in the analysis of the pier is as follows:

1. Distribution of loads to stringers and determination of fixed end moments. For every live-load position defined in the input data, the program distributes the load to the appropriate stringers in the following manner. Using the distance from the origin to the left wheel of an axle, the program searches the respective distances from the origin to each of the stringers, and determines if the wheel is cantilevered beyond an outer stringer or is located between two stringers. A wheel cantilevered beyond an outer stringer is distributed to that outside stringer and the one adjacent to it. A wheel load between two stringers is distributed to those two stringers. The distance from the origin to the right wheel is obtained by adding the axle width to the distance between the origin and the left wheel. A search by the program of the stringer locations determines those stringers to which the load on the right wheel is distributed.

The program, by comparing stringer and column distances (from the origin), selects those specific stringers which contribute to the fixed end moments in each cap span between adjacent columns. The fixed end moments in the cap are then computed for each live-load position.

For a change in temperature, the fixed end moments evaluated by the program for the pier of Fig. 1 are given in Eqs. 3 through 7 in the accompanying box.

α = coefficient of thermal expansion
ΔT = change in temperature

For wind-load conditions, the program determines fixed end moments in the cap members caused by vertical stringer loads resulting from the action of wind on the superstructure and on vehicles on the deck. In addition, fixed end moments in the columns must be calculated, since there are uniformly distributed wind forces acting on them.

The program also recognizes stringers on cantilevered sections (if any) and computes the moments in the cap at the outer columns resulting from these loads, as well as fixed end moments for all the loading conditions. These values of fixed end moments are now available for substitution in the slope deflection equations.

2. Formulation and solution of simultaneous equations. As a preliminary to solving for the rotations θ and translation Δ for each loading condition, the equilibrium equations for each joint in the frame, and for the frame as a whole, must be expressed in slope deflection form. For the structure shown in Fig. 1, for example, the equilibrium equations for a centrifugal force H acting on the structure are Eqs. 8 through 11 in the accompanying box.

Expressing the bending moments in the above equations in slope deflection form (Eqs. 1 and 2), the simultaneous equations actually programmed and used by the computer are Eqs. 12 through 15 in the box.

Since the coefficients of θ and Δ in the simultaneous equations are a function of the stiffness and carryover factors of the members, and of the column heights, they are computed only once by the program for use in all loading conditions. The constants on the right side of the equations, being a function of applied horizontal forces and fixed end moments, are computed by the program for each group of loads.

3. Evaluation of end moments. The program then substitutes the rotations, deflections and fixed end moments into the original slope deflection expressions (Eqs. 1 and 2), and the moments at the ends of each of the members are evaluated.

4. Computation of forces and ad-

ditional moments. The program proceeds to isolate each span in the cap as a free body between the joints at the ends of the member. Using the moments at the ends of the member and the applied loads, the program computes the vertical shears at the center lines of the columns and the shears and bending moments at the faces of columns and at each stringer. Isolating each column as a free body, and utilizing the shears computed in the cap at each column center line, plus the loads on the column and the moments at the ends of the column, the program calculates the vertical and horizontal forces acting at the tops and bottoms of the columns.

5. Formulation of design combinations. Of particular interest to the bridge designer are the effects, on the frame, of vehicles in various positions on the deck. In a multilane roadway, any one of the lanes may carry traffic individually, or any group of lanes may be loaded simultaneously. It is also possible for vehicles to occupy different positions within a given lane. An integral part of the program is the analysis of the pier for the various possible live-load positions, followed by the formation and selection of the maximum and minimum design values for the frame.

The program is capable of analyzing a pier and determining the moments and forces at cap and column sections, for two live-load positions in each of a maximum of six lanes. For each section, by using the values for the individual live-load positions, the program proceeds to obtain the moments and forces corresponding to all possible combinations of live-load positions.

The program then compares the combinations of moments and forces formed for each of the frame sections, and maximum and minimum design values are selected, taking into consideration that the two live-load positions in a given lane are mutually exclusive. Also taken into account in selecting critical values are design code specifications permitting a reduction of 10 percent in stresses produced by loading three lanes simultaneously, and a reduction of 25 percent in stresses produced by loading four or more lanes simultaneously.

Output of program

For each loading condition, the printed output of the program consists of the bending moments and the vertical shearing forces acting at the faces of columns and at all stringers supported on the cap. In addition, at the top and bottom of each column, the output consists of the vertical force, the horizontal force, and the bending moment.

As a result of comparing the combinations of live-load moments and forces, the printed output contains, for the bottoms of columns, maximum and minimum live-load vertical forces and the corresponding moments and horizontal forces. Included, at the same sections, are the maximum and minimum live-load moments and the corresponding vertical and horizontal forces. At the tops of columns and for the cap sections at stringers and column faces, maximum and minimum live-load values are also given.

The entire computation is completely automatic, requiring no intermediate evaluation by a designer. The program, and the basic input data, are entered into the electronic computer, and the entire operation is under the control of the program. The computer machine time required for the Phase I analysis of a five-column bent, supporting 20 stringers, and considering 19 loading conditions, is approximately 25 min.

EQUATIONS

Slope deflection equations for bending moments at ends of member AB (Fig. 2):

$$M_{AB} = K_{AB}\,[\theta_A + r_{AB}\,\theta_B - (1 + r_{AB})\,\Delta \div l_{AB}] + M^F{}_{AB} \qquad (1)$$

$$M_{BA} = K_{BA}\,[\theta_B + r_{BA}\,\theta_A - (1 + r_{BA})\,\Delta \div l_{AB}] + M^F{}_{BA} \qquad (2)$$

Fixed-end moments for change of temperature, for pier of Fig. 1:

$$M^F{}_{SR} = M^F{}_{RS} = 0 \qquad (3)$$

$$M^F{}_{UT} = M^F{}_{TU} = -K_{UT}\,(1 + r_{UT})\,(\alpha\, l_1\, \Delta T) \div h_2 \qquad (4)$$

$$M^F{}_{WV} = M^F{}_{VW} = -K_{WV}\,(1 + r_{WV})\,[\alpha\,(l_1 + l_2)\,\Delta T] \div h_3 \qquad (5)$$

$$M^F{}_{SU} = M^F{}_{US} = K_{SU}\,(1 + r_{SU})\,[\alpha\,(h_2 - h_1)\,\Delta T] \div l_1 \qquad (6)$$

$$M^F{}_{UW} = M^F{}_{WU} = K_{UW}\,(1 + r_{UW})\,[\alpha\,(h_3 - h_2)\,\Delta T] \div l_2 \qquad (7)$$

Equilibrium equations for centrifugal force H acting on structure:

$$M_{SR} + M_{SU} = 0 \qquad (8)$$

$$M_{US} + M_{UT} + M_{UW} = 0 \qquad (9)$$

$$M_{WU} + M_{WV} = 0 \qquad (10)$$

$$\frac{M_{SR} + M_{RS}}{h_1} + \frac{M_{UT} + M_{TU}}{h_2} + \frac{M_{WV} + M_{VW}}{h_3} = H \qquad (11)$$

Bending moments in above equations expressed in slope deflection form, give simultaneous equations actually programmed and used by computer:

$$(K_{SR} + K_{SU})\,\theta_S + (K_{SU}\,r_{SU})\,\theta_U \quad \frac{-K_{SR}\,(1 + r_{SR})}{h_1}\Delta = -M^F{}_{SU} \qquad (12)$$

$$(K_{SU}\,r_{SU})\,\theta_S + (K_{US} + K_{UT} + K_{UW})\,\theta_U + (K_{UW}\,r_{UW})\,\theta_W - \frac{K_{UT}\,(1 + r_{UT})}{h_2}\Delta = -(M^F{}_{US} + M^F{}_{UW}) \qquad (13)$$

$$(K_{UW}\,r_{UW})\,\theta_U + (K_{WV} + K_{WU})\,\theta_W - \frac{K_{WV}\,(1 + r_{WV})}{h_3}\Delta = -M^F{}_{WU} \qquad (14)$$

$$\frac{K_{SR}\,(1 + r_{SR})}{h_1}\,\theta_S + \frac{K_{UT}\,(1 + r_{UT})}{h_2}\,\theta_U + \frac{K_{WV}\,(1 + r_{WV})}{h_3}\,\theta_W - \left[\frac{K_{SR} + 2\,K_{SR}\,r_{SR} + K_{RS}}{h^2{}_1} + \frac{K_{UT} + 2\,K_{UT}\,r_{UT} + K_{TU}}{h^2{}_2} + \frac{K_{WV} + 2\,K_{WV}\,r_{WV} + K_{VW}}{h^2{}_3}\right]\Delta = H \qquad (15)$$

FIG. 2. Punched cards represent initial values fed to machine to yield solutions needed as input for main program, which follows.

Designing steel bridges by computer

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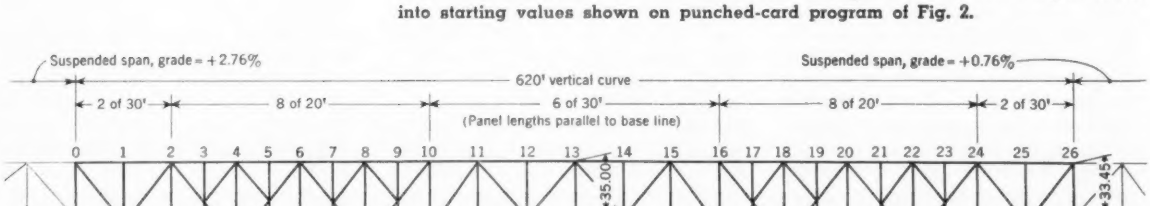
Before discussing the design of steel bridges by computer, as worked out by the American Bridge Division of the U. S. Steel Corporation, it is desirable to comment on the problems of the individual engineer when he tries to decide whether or not a computer will be helpful to him in his own particular field.

Intelligent use of high-speed computers for engineering work is a rather complex subject that would benefit greatly from some clarification. A ready resolution of this difficulty is not easy. The difficulty lies in attempting to apply principles to situations vastly different from those for which the principles were originally developed. Yet in a field so new, that is expanding so rapidly, it is only reasonable to expect that, in the early stages, a lot of error is generated along with the truth. Certainly then, the first objective is to distill a few facts from the murky waters.

First, consider the computer itself. Many have feared to approach electronic computation because of the atmosphere of mystery that seems to surround many installations. Basically, however, an electronic calculator is merely a calculating machine whose primary appeal lies in its speed and convenience. A large majority of those holding drivers' licenses know little or nothing about automobiles, yet they use these conveyances as a rapid and convenient mode of transportation. Nor do we hesitate to take advantage of radio, television, jet airliners, or electricity generated by atomic power just because we do not understand the exact details of their operation. Similarly, computers can be used to great profit with only a limited knowledge of their working parts.

On the other hand, just as a misuse of these modern devices can cause disaster, so also the blind utilization of high-speed calculators can lead to great dissatisfaction. Except in the improbable case where exactly identical prob-

FIG. 1. Data shown here were translated, through use of a few simple codes, into starting values shown on punched-card program of Fig. 2.



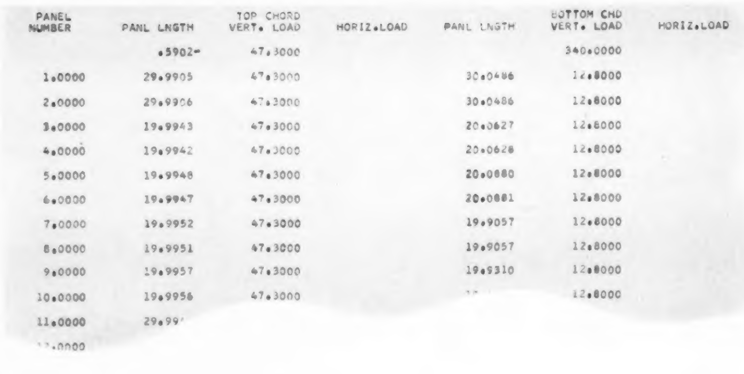
Loads:

Top chord, 47.3 kips at each panel point
Bottom chord, 12.8 kips at each panel point plus 327.2 kips at L_0 and L_{26}

Geometric data:

All verticals perpendicular to base line
Top chord points 0, 2, 4, 6, 8, 10, 11, 13, etc. to follow vertical curve
Even numbered bottom chord points to follow circular curve (radius = 600 ft)

FIG. 3. **Quantities from punched cards of Fig. 2 are reproduced in main program and become a part of its output, here shown.**



PANEL NUMBER	PANL LNGTH	TOP CHORD VERT. LOAD	HORIZ.LOAD	PANL LNGTH	BOTTOM CHD VERT. LOAD	HORIZ.LOAD
	.5902-	47.3000			340.0000	
1.0000	29.9905	47.3000		30.0486	12.8000	
2.0000	29.9906	47.3000		30.0486	12.8000	
3.0000	19.9943	47.3000		20.0627	12.8000	
4.0000	19.9942	47.3000		20.0628	12.8000	
5.0000	19.9948	47.3000		20.0880	12.8000	
6.0000	19.9947	47.3000		20.0881	12.8000	
7.0000	19.9952	47.3000		19.9057	12.8000	
8.0000	19.9951	47.3000		19.9057	12.8000	
9.0000	19.9957	47.3000		19.9310	12.8000	
10.0000	19.9956	47.3000		[illegible]	12.8000	
11.0000	29.99					
[illegible]						

lems occur, the blind adoption of developments carried out by others is likely to fall in this category. The efforts of others should be used as a guide rather than a prototype. The ideal approach may be simply stated: Assume that a computer can help solve your problem and then acquire, either by yourself or through others, adequate knowledge of how to utilize its help to the best advantage.

The reputation of computers for handling complicated work is well founded. Recent advances in the manufacturing art have made the latest models capable of solving problems of increasing complexity, until the point has been reached where it is almost safe to say that if a problem can be stated, there is a machine that can solve it. In the other direction, improvements in the systems whereby the actual work is translated into language intelligible to the machine, have continued to reduce the degree of repetition or difficulty required for practical machine solution.

As the user solves more complicated problems he builds up a library of machine instructions, called programs, which are then available for subsequent problems. Many problems that were not feasible for solution by high-speed computer a few years ago can now be easily handled, assuming that a machine is available. This brings us to the second main point, which is that the availability of equipment is generally the main determinant as to whether a given problem can be practicably solved by computer or not.

The third and last point of general significance is concerned with the approach to the problem. While the preceding paragraphs have emphasized the fact that a minute knowledge of computers is not required, and implied that computers are easy to use, a warning has been given that blind utilization can lead to undesirable consequences. In many cases this means that the method of solution should be carefully selected to match the machine's capabilities. Frequently in the past, the approach to a problem has been dictated by the way it would be solved by manual methods. In manual calculations, rationalizations and approximations necessarily replace more exact procedures so that practical solutions can be obtained within a reasonable time. With the advent of electric desk calculators, alternate approaches were developed to take fuller advantage of these devices. Electronic computation will permit even more exact approaches.

Electronic computers are extremely versatile and the methods developed for manual or desk calculator techniques can be used for them without change. There are numerous cases where this should be done, either because preferable methods are not available, or because refined techniques are not required. Conversely, a more intimate knowledge of both the problem and the computer can frequently lead to one or more of the following advantages: easier translation of the problem into machine language, easier preparation of data for specific cases, cheaper and more efficient use of the equipment, more accurate results, and greater flexibility.

Most current evidence indicates that, for truly effective utilization of an electronic computer, some specialized education is needed in the way the machine functions. This should be combined, in the same person, with a realistic knowledge of the problem. There are a few notable exceptions where excellent progress has been made by groups where these two types of knowledge were not possessed by the same individuals, but such examples should be recognized as exceptions. The ideal blending of the requirements of the problem and of the equipment is almost impossible to achieve, unless adequate knowledge of each can be brought to common ground. In one sense it is unfortunate that computers are as good as they are. Because of this, poorly planned solutions by machine methods can still show an economic advantage over manual techniques. Yet, if the proper thought and knowledge had been applied to the problem, the advantage could have been increased many fold by an improved computer solution. Thus many sins are committed in the name of mechanization, and progress is hampered by the abortive efforts of those suffering from inadequate training.

By oversimplifying this dilemma, it may be said that all problems fall into two classes—those that can profit from professional computer techniques and those for which such techniques would be a wasteful overrefinement. Almost without exception the only person capable of deciding into which class a problem falls, and what degree of refinement it demands, is the one who thoroughly knows both the problem and the computer. His decision will prevent attacking mice with cannons or elephants with popguns. Once his decision has been reached, less versatile personnel can complete the assignment.

The preceding generalizations were developed during several years of experience with the engineering computer program of the United States Steel Corporation and, in particular, its American Bridge Division. While structural analysis played a major role in initiating this program, it now represents considerably less than half the total effort. Probably a similar trend will occur in other fields. Conclusions from this experience may be summarized thus: the intelligent use of high-speed computers (with minor exceptions) will prove advantageous for all engineers in solving their quantitative problems if the proper foundation has been laid.

On the surface this may appear doubtful in the case of the individual engineer as contrasted with the large engineering organization. Closer scrutiny reveals that this is not necessarily the case. Rather it points to the need for an extremely simple, automatic machine language that the potential user can quickly learn. Considerable progress has been made in this field. While the present results are not to be considered as final, very workable systems have been obtained. In the early stages of developing computer techniques, there was a need for

PANEL NUMBER	TOP CHORD	S T BOTT.CHORD	R E U.DIAGONAL	S S L.DIAGONAL	U.VERTICAL	L.VERTICAL
					340.5507	340.5506
1.0001	317.5363	6.0294	498.4961-		47.2840-	47.2837-
2.0002	318.3710	623.2728-	491.7926		40.4733-	40.4735-
3.0003	952.8751	630.6156-	502.9296-		47.2815-	12.8376
4.0004	953.7095	630.3859-	39.3413	541.9846-	108.6866-	108.6867-
5.0005	954.5217	1284.5248-	39.1042	429.8850	47.2922-	12.8639
6.0006	955.3574	1284.2920-	469.2270		482.8327-	482.8328-
7.0007	1194.0911	1304.8933-	97.4435		47.2826-	12.7460
8.0008	1194.9255	1304.6599-	39.0866	58.5425	108.9041-	108.9041-
9.0009	1195.7476	1225.7967-	38.9335	32.1685-	47.2834-	12.7545
10.0010	1196.5834	1225.5663-	6.8980		53.9503-	53.9492-
11.0011	[illegible]	[illegible]91-	47.7464-		[illegible]	[illegible]

FIG. 4. Among the codes initially read by the computer is one specifying what values of output are required. Here only reactions and stresses were specified.

the interchange of programs to get projects under way. This in turn resulted in some of the abuses previously mentioned. Now we are rapidly approaching the time when most of this need will be wiped out by the ability of the individual to instruct the computer in simple language to execute a program tailored to his own specific problems. Even so, for certain types of calculations, because of their repetitive nature or complex pattern, it will be more advantageous to have the programming done by a computer expert than by the individual user.

Application to structural problems

While the truss program of the American Bridge Division is an old story, it remains as a useful example of how to approach a problem. Of course it is obvious that the best method of attack for American Bridge may not necessarily be the best for some other group.

The first thing to be considered was what results were to be obtained and from what data. In our case the desired answers were the length and slope of the individual members, the magnitude and kind of stress in each member, the deformation due to stress and temperature, the reactions at the supports, and the deflections at intermediate points. The starting values were the horizontal and vertical loads applied to the structure, the type of web system, the controlling geometric dimensions, the areas of the members, and the locations of the reactions. Obviously not all the answers listed above would be required for each solution. Nor was there any assurance that the initial data would always be presented in the same form. It was therefore immediately recognized that a high degree of flexibility would be desirable for input and output of this program.

In selecting one type of computer input—the configuration of the web system—only simple programming systems were initially considered. It soon became evident that such an approach was woefully inadequate. Experience indicated that, in addition to Warren, Pratt and Howe trusses, there was a demand for K-trusses and subdivided panel arrangements. This was not an arbitrary decision but one forced on us by the desires of various designers. Studies of the types of structures involved included multiple span, continuous and cantilever bridges, large roof trusses, and ore bridges. The results indicated that alternate programs for various types of trussses were not the answer because frequently the various types appeared in combination.

Additional consideration revealed that any program based on a fixed number of panels would be too restricted to be of any value, and that there would never be any guarantee that panel lengths would remain constant, or that the truss would be level rather than on a grade, or that various dimensions would not be referred to vertical curves. Moreover, would the "verticals" be truly vertical? Would they be perpendicular to the grade or chord? Or would they bisect the angle made by adjoining chords, and if the latter, would it be the top or the bottom chord that would govern? It was concluded that a practical truss program must be flexible as to number of panels, panel lengths, panel-point elevations, and type of web system.

The next type of input to be taken into account was the loading pattern. The decision was quickly reached that provision had to be made for the presence or absence of both horizontal and vertical loads of various magnitudes and directions at each panel point, with reactions occurring at any panel point.

The extreme versatility demanded in a program to handle this wide variety of input could only result in an extremely unwieldy situation, where at least nine values had to be specified for each panel, many of which had to be precalculated. The answer to this problem was not to restrict the program and reduce flexibility, thereby minimizing the number of starting values required, but rather to write a prefix program that could operate on a small amount of data to do all the necessary precalculations and develop each of the values required for the more ambitious overall program.

Thus, through the use of a few simple codes, the data in Fig. 1 were translated to the starting values shown on the punched-card program of Fig. 2. For verification, to ensure that the proper values were used and to indicate the exact condition being investigated for future reference, these quantities are reproduced in the main program and become a part of its output, as shown in Fig. 3. Among the codes initially read by the computer is one specifying what values of output are required. For this sample only the reactions and stresses were specified. The results appeared in the form shown in Fig. 4.

While conventional methods or combinations of conventional methods are used in this program, one point is worthy of mention. For the solution of indeterminate structures, the method of virtual work was selected as best suited to the computer and the user's needs. The three-moment theorem, which would be considerably less accurate and more difficult to use, is actually less well suited to this computer. Other experience has also shown that the more exact method is frequently preferable for use in a high-speed calculator even though the additional accuracy may not be needed.

At this point it is obvious why a combined engineer and computer expert is of prime importance. Only he is in the position to know exactly what is required on the one hand and how the program can be developed on the other. Perhaps even more significant, only he can say how much effort can profitably be expended on a particular problem.

The use of computers for engineering work will expand rapidly in the near future. In preparing for that day it may be said again that the ideal approach for the engineer is to assume that a computer can help solve his problems, and then to acquire adequate knowledge of *how* it can best help him.

Some applications of a digital computer in

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Since its completion in 1952, the electronic digital computer of the University of Illinois, the ILLIAC, has been of great value in structural engineering research. In this article are described a few of the problems that have been solved with the aid of this computer. The examples presented include: (1) two problems in plate analysis that involve the solution of a system of simultaneous linear algebraic equations; (2) a problem of free vibration of frameworks involving the determination of the characteristic roots and vectors of matrices, and (3) problems of dynamic structural response which involve the integration of linear or non-linear differential equations.

The ILLIAC is a large-scale digital computer which uses the binary number system (to the base 2). Its electrostatic memory can store 1024 words with 40 binary digits each. A 40-digit binary number is equivalent approximately to a 12-digit decimal number. It takes 90 μsec to add or subtract two numbers. Multiplication and division require about 700 μsec and 950 μsec respectively. Transfer of a number to or from the memory requires 25 μsec. [1 μsec (microsecond) = one millionth of a second.]

Numerical data and instructions are read by the computer from a punched tape at the rate of 250 characters per sec. Information obtained from the computer is commonly punched on a tape at the rate of 50 characters per sec and then printed on a teletype printer. A cathode-ray oscilloscope is also available for output displays at the rate of 1000 characters per sec. By photographing the display it is possible to obtain a permanent record of the results displayed. It is noted that the speeds at which information can be supplied to, or obtained from, the ILLIAC are significantly slower than those at which arithmetic operations can be performed.

In addition to the electrostatic memory, the ILLIAC has an auxiliary magnetic-drum memory with a capacity of 12,800 words. The time required to gain access to the drum memory is about 450 times greater than that for the electrostatic memory. Consequently the drum memory is used only when the capacity of the electrostatic memory is exceeded.

Analysis of skew I-beam bridges

One of the simpler applications of the ILLIAC was concerned with the analysis of simply supported skew I-beam bridges.[1] The structure investigated consists of a reinforced concrete slab in the form of a parallelogram supported on five equally spaced, flexible steel girders which are parallel to one pair of sides of the slab and simply supported at the ends. The girders are considered to be identical and of constant cross section.

Analysis of this problem involves the solution of the differential equation for plates subject to the appropriate boundary conditions. In this study an approximate solution was obtained using the method of finite differences. A network of 63 node points was considered, formed by the intersection of two sets of parallel lines. The first set of lines, drawn parallel to the abutments, divides the span into eight equal segments, while the second set, drawn parallel to the girders, divides each slab panel into two equal segments. By writing a difference equation for every node point, we obtain a system of 63 simultaneous, linear, algebraic equations, the solution of which provides the values of the deflection at those points. By resolving the loading into symmetrical and antisymmetrical components, the analysis of a particular structure was reduced to the solution of two sets of equations, one having 32 equations and the other 31. The complete solution was then obtained by adding the solutions corresponding to the symmetrical and antisymmetrical components of loading.

Routines for the solution of a system of simultaneous linear algebraic equations can commonly be found among the standard library routines maintained with most computers. The routine available for use with the ILLIAC can handle up to 39 equations, using only the electrostatic memory of the computer, and up to 142 equations by utilizing the auxiliary magnetic-drum memory. (The drum memory was not available at the time this investigation was conducted.) It takes about 3.5 min. to solve a set of 39 equations and to punch the answers to 11 decimal places, the greater part of the time being taken up by the punching operation. The time required for the solution of 142 simultaneous equations is approximately an hour and a half. To use this routine it is necessary to specify the numerical values of the coefficients of the unknowns and the constant terms.

For the problem considered, the coefficients of the unknowns are functions of the angle of skew, the ratio of girder spacing to span length, and the relative stiffness of the girders and the slab, while the constant terms depend on the loading. In this study a special routine was developed for evaluating these coefficients within the ILLIAC, and the standard library routine was used to solve the simultaneous equations.

A total of 18 skew bridges having different proportions and physical characteristics have been analyzed. The analyses necessitated the solution of 306 sets of simultaneous equations, each having 31 or 32 equations. It took the ILLIAC less than 3.5 min. to compute the coefficients and solve a set of 32 equations, or about 18 hours to solve the 306 sets. On an electric desk calculator, a minimum of 30 hours would have been required for the solution of one set of equations.

The solutions obtained provided influence surfaces for bending moment at a number of points. With the aid of these influence surfaces, maximum live-load moments at midspan of the girders were computed for standard

Magnetic drum memory of ILLIAC can store 12,800 words beyond the capacity of the electrostatic memory.

In teletype room of the University's Digital Computer Laboratory, information is transferred to and from tape. Available equipment includes: (1) keyboard perforators used to punch instruction and data tapes; (2) page printers used to transcribe information from a tape to a printed page; (3) a reperforator unit for duplicating tapes; (4) combination units that combine the functions of the preceding three units, and (5) a tape comparer unit.

trucks. Based on these results, empirical relationships were developed for use in practical applications.

The computation of the coefficients of the simultaneous equations within the machine reduced the machine time, the human time required to prepare the parameter tapes, and also the probability of errors in the preparation of these tapes. Experience indicates that the frequency of human errors increases rapidly as the amount of information included on a tape is increased. By comparison the ILLIAC is error-proof.

The second example to be described is taken from an investigation of floor slabs and plates with various support conditions. This problem involved the analysis of the interior panel of a long rectangular plate of uniform thickness which is fixed along one edge, free along the opposite edge, and continuous in one direction over a series of equally spaced, flexible beams. The beams were considered to be identical, of constant cross section, and placed perpendicular to the fixed edge. The plate itself was considered to be orthotropic, that is, to have different stiffnesses in two mutually perpendicular directions. Grid systems, one-way or two-way ribbed floors, plates with closely spaced stiffeners, corrugated or laminated sheets, are examples of orthotropic plate construction. The loading considered included a uniform pressure and a hydrostatic pressure varying from a zero value at the free edge to a maximum value at the fixed edge.

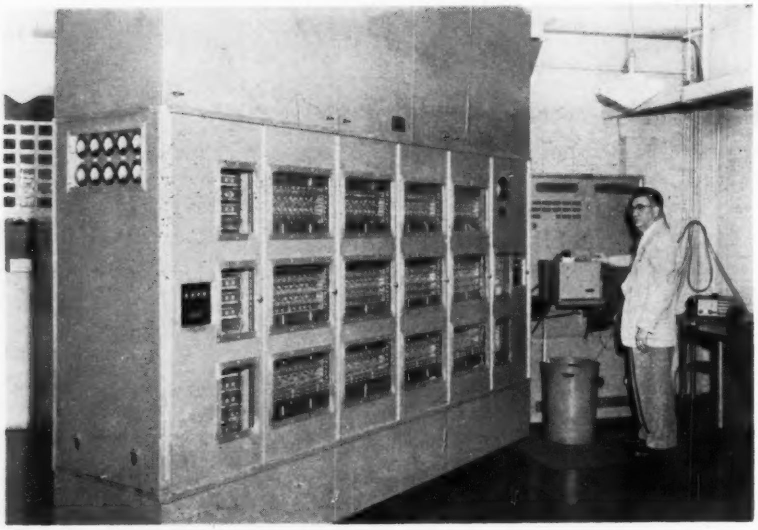
The problem was analyzed by means of the Rayleigh-Ritz energy procedure. The deflection of the plate, w, was expressed by the equation

$$w = \Sigma \Sigma A_{mn} X_m Y_n + \Sigma B_m X_m$$

where X_m represents a set of polynomials in x satisfying the boundary conditions for a cantilever beam, and Y_n represents a set of polynomials in y satisfying the boundary conditions for a fixed-end beam. The x-axis is considered to be parallel to the beams. The quantities A_{mn} and B_n are coefficients to be determined.

By minimizing the expression for the total energy of the system, there is obtained an infinite set of simultaneous, linear, algebraic equations, the solution of which yields the values of A_{mn}. Because of the properties of the functions used, the coefficients B_m do not appear in this system of equations; their values can readily be determined from the values of A_{mn}. In general, such an infinite set of equations is solved approximately by considering a finite number of equations, the accuracy of the solution being obviously dependent on the number of equations considered.

In this investigation all major computations were performed on the ILLIAC. The program that was prepared includes (1) a routine which, for a given set of parameters defining the characteristics of the plate, is used to compute the coefficients of the system of simultaneous equations, (2) the standard library routine for solving



ILLIAC, digital computer of the University of Illinois, has a high-speed electrostatic memory with a capacity of 1024 words and an auxiliary magnetic drum memory. (The drum memory unit is shown on preceding page.)

these equations, and (3) a routine for evaluating the deflection, moment and shear at specified points and the average moment and shear across certain sections. The program is arranged so that it is possible to consider 4, 9, 16 or 25 terms in the series and, by studying the rate of convergence of the results, obtain an indication of the accuracy of the solution. It takes less than 3 minutes to obtain a complete solution involving 25 simultaneous equations and to punch the results.

Numerical solutions have been obtained for over one hundred problems considering various ratios of sides, degrees of orthotropy, and ratios of beam to plate rigidities. These solutions are now being summarized in a form convenient for use by practicing engineers.

Another application of the ILLIAC was concerned with the determination of the natural frequencies and modes of vibration of multistory building frames having flexible girders.[2] The mass of the structure was considered to be concentrated at the intersections of columns and girders, and the effect of damping was neglected.

The problem involves the solution of a system of *homogeneous*, linear, algebraic equations, the number of equations being equal to the number of stories. Obtained by applying Newton's second law of motion to each floor, the equations have the form:

$$Q_j - m_j \omega^2 x_j = 0$$

where m_j and x_j represent, respectively, the total mass and the deflection of the jth floor, and ω represents the circular frequency of vibration. The total resisting force acting on the jth mass, Q_j, is given by the equation

$$Q_j = q_{j1}x_1 + q_{j2}x_2 + \ldots + q_{jr}x_r + \ldots + q_{jn}x_n$$

where q_{jr} denotes the total resisting force on the jth floor when the rth floor is displaced by a unit distance while all the other floors are held against translation.

If this system of equations is to have a non-trivial solution, the determinant of the coefficients of the unknowns must vanish. In matrix notation, the resulting determinantal equation is

$$| A - \omega^2 B | = 0$$

where A is a symmetrical matrix of the stiffness coefficients q, and B is a diagonal matrix of the masses. The characteristic roots and vectors of this equation correspond to the natural frequencies and modes of vibration of the system.

Standard library routines for the solution of this type of determinantal equation are available for use with most high-speed computers. The ILLIAC routine now available can handle matrices of the order 19 or less. In this investigation both the computation of the stiffness matrix A and the solution of the determinantal equation were carried out on the ILLIAC.

The procedure used for calculating the stiffness matrix starts on the assumption that the first story of the structure has been deflected by a unit distance while the remaining floors are fixed against rotation and translation. Next, the resulting fixed-end moments are determined, and the values of the final moments at the joints are computed by means of moment distribution. The resisting forces at the various floor levels are then evaluated and stored at appropriate memory locations. These forces represent the first column of the stiffness matrix A. It should be noted that, throughout this moment distribution process, all joints are considered to be fixed against translation. This cycle of computations is then repeated by considering successively unit displacements for the remaining floors, until the complete matrix has been formed.

Numerical solutions for natural frequencies have been obtained for single-bay and multiple-bay frames having a different number of stories and various ratios of girder stiffness to column stiffness. Based on these results, simple empirical equations have been developed for use in practical applications

It may be of interest to note that the moment distribution routine used in the computation of the stiffness matrix is part of a more general program, originally developed for the analysis of continuous beams on rigid supports and continuous frames without sidesway. Programs are also available for the analysis of multistory building frames for which the joints are free to translate.

Dynamic response of buildings

During the past five years, the ILLIAC has been used extensively in investigations of dynamic response of buildings subjected to the action of wind pressures, forces due to air blast, and ground disturbances such as those arising from earthquakes.

If the mass of the structure is considered to be concentrated at the intersections of columns and girders, the analysis of these problems involves the solution of a system of second-order, linear or non-linear differential equations with constant coefficients, the number of equations being usually equal to the number of stories. The equation for the jth floor may be written as

$$m_j \ddot{x}_j + D_j + Q_j = P_j$$

where m_j and $\ddot{x}_j$ denote the mass and the acceleration of the jth mass, and D_j, Q_j and P_j represent, respectively, the damping force, the resisting spring force, and the external disturbing force acting on the jth floor. The force Q_j is a function of displacements whereas D_j is a function of velocities.

This system of equations can conveniently be solved by a numerical method of step-by-step integration. In this method, the time coordinate is divided into a number of short intervals, and

during each interval the integration is carried out by an iterative scheme. It may be of interest to review here the steps involved. Let it be assumed that at some time, t_n, the values of the displacements, velocities, and accelerations of all the floors are known, and that it is desired to determine the corresponding quantities for a time, t_{n+1}, which differs from t_n by the small interval Δt.

The solution is started by assuming for each floor the values of the accelerations at the end of the time interval. Normally, these values are taken equal to those for the beginning of the interval. From these trial accelerations, the velocity and displacement of each floor at the end of the interval are computed by means of appropriate quadrature formulas. (See, for example, Ref. 3.) From these quantities, the damping force D_j and the resisting force Q_j are then evaluated and, by application of the governing differential equation, a new set of accelerations is determined.

If the derived accelerations do not agree with the assumed values, the computations are repeated using the derived values as the initial assumed values. When a satisfactory degree of agreement is reached between assumed and derived accelerations, the researcher can proceed to the next time interval and repeat the procedure. Because of its cyclic nature, this method of solution is well suited for use with a digital computer. The resisting force Q_j need not be a linear function of displacements, the same method being applicable both in the elastic and in the inelastic or non-linear range of behavior.

A number of programs have been developed for the computation of dynamic response of systems having one or many degrees of freedom. With the programs now available for single-degree-of-freedom systems, it is possible to consider almost any force-time relationship and any resistance-deformation relationship that can be approximated by a series of straight lines. With the aid of these programs, extensive solutions have been obtained for various loading and resistance functions, and the results have been summarized in a series of charts.[4] These charts make it possible to determine rapidly the maximum structural response for known loading and resistance parameters, or the loading required to produce a given maximum response.

With the available programs for the analysis of elastic systems, it is possible to consider tall buildings with infinitely rigid floors having as many as 64 stories.[5] Damping in the structure can be considered to be proportional either to the absolute floor velocity or to the relative velocity between floors. These programs were used to compute the maximum dynamic shears in 8-story and 10-story building frames subjected to the action of actual earthquake motions.[5,6] Each problem required from 20 to 30 min. of machine time. Additional studies relating to the response of structures to earthquakes are currently under way.

Programs are also available for the analysis of multistory buildings in the inelastic range of behavior. For buildings with rigid floors, a bilinear resistance-deformation relationship is considered for each story; for buildings with flexible girders, an elastoplastic moment-curvature relationship is considered for each member.[7] Space limitations prevent a more detailed description of these programs.

Dynamic response of highway bridges

One of the more elaborate applications of the ILLIAC was concerned with the dynamic analysis of simple-span highway bridges under the passage of heavy vehicles. In this investigation the bridge was idealized as a simply supported, elastic beam of uniform mass and cross section; the vehicle was represented as a two-axle load unit, consisting of a sprung mass connected to two unsprung masses through two linearly elastic springs.

In the analysis of this system,[8] the beam was treated as a single-degree-of-freedom system. Specifically, it was assumed that the deflection configuration of the beam at any instant is proportional to the static configuration produced by the moving load and the weight of the beam itself. It was further assumed that, while on the span, the vehicle remains in contact with the bridge at all times. With these simplifications the behavior of the system can be expressed in terms of three simultaneous, second-order, linear, differential equations with variable coefficients.

These equations have been programmed for solution on the ILLIAC using the step-by-step method of integration described previously. With the program developed,[8] it is possible to consider any practical combination of the physical parameters which enter into the problem, such as the speed of the vehicle, the weights and natural frequencies of the vehicle and the bridge, and the spacing of the axles. It is also possible to consider the influence of initial oscillation of the beam and initial vertical or angular oscillation of the sprung mass. The effects of roadway uneveness can also be investigated.

The program can handle a sinusoidal profile variation with up to 33 half sine waves along the span, and any other non-systematic profile variation that can be prescribed by the values of ordinates at one hundred points, equally spaced between the supports of the beam. The results computed include the ratio of the dynamic to the maximum static moment at midspan and at sections underneath the axles, and also the dynamic deflection and the maximum static deflection at midspan.

A complete solution, including the time required for punching the results, is obtained in about 3 min. If only the maximum values of moment and deflection are desired, they can be obtained in about 2 min. The preparation of this program took approximately 1200 man-hours.

In this investigation several hundred solutions have been obtained to evaluate the influence and relative importance of the various variables involved. These studies are now being continued.

The studies described here were performed in the Department of Civil Engineering under the general direction of Dr. N. M. Newmark, M.ASCE, Head of the Department. This work represents the effort of a number of individuals and was sponsored by a number of different organizations. The detailed list is too voluminous to include here. Appreciation is expressed to all those who made this presentation possible.

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(This article is based on a talk presented at the Society's New York Annual Convention, before the Engineering Mechanics Division session on analog and digital computers, sponsored jointly by the Division's Committee on Experimental Analysis and Analogs and its Committee on Mathematical Methods. Walter J. Austin, chairman of the latter committee, presided.)

Columbia Basin streamflow routing by computer

DAVID M. ROCKWOOD, A.M. ASCE, Hydraulic Engineer, U.S. Army Engineers, Portland, Ore.

Among the many types of engineering problems involving great masses of computations are those encountered in hydrologic practice for synthesizing streamflow. This article describes a method developed to provide a direct and objective streamflow forecasting procedure for periods up to 10 days in advance in the Columbia River Basin. It can also be used for design flood determinations or reservoir regulation studies.

The procedure utilizes a new technique for streamflow routing, which is made practical by the capabilities of a medium-speed electronic digital computer. The primary capabilities of electronic digital computers, when applied to streamflow forecasting, are their ability to:

1. Handle large amounts of input data, which are used to define the initial streamflow condition and forecasts of hydrometeorological events.
2. Perform rapid arithmetic computations, for routing streamflow in small finite increments of time and storage.
3. Follow a predetermined series of instructions, which automatically directs the arithmetic and data processing operation.
4. Store numerous digital values representing basin, channel, or lake routing coefficients for use as directed by the basic program of instructions.
5. Provide digital output values successively through the operation, these values being used for defining forecasts of streamflow at key gaging stations.

Program development

The program was developed in the office of the Division Engineer, U.S. Army Engineer Division, North Pacific, which supervises the planning and operation of several major water control projects in the Columbia River Basin. Daily reservoir regulation problems as well as project design computations require the use of a streamflow routing technique for the entire basin. The problem involves synthesizing streamflow for the component subbasins and routing streamflow through lakes, reservoirs, and channels to predict the flow at key downstream gaging stations. The essential requirements for this procedure are:

1. The time increment must be small enough to represent fluctuations of flow in tributaries—normally 6 hours.
2. The total time for preparation of forecasts, from receipt of basic data to derivation of forecasted flows, should be less than 4 hours.
3. The method must be flexible, so that streamflow values can be adjusted periodically (usually daily) in accordance with observed conditions.
4. The method of applying forecast values for input of water supply (in the form of rainfall, snowmelt excesses, or streamflow) should permit the application of more than one forecast condition for a forecast period.

During August 1956 the North Pacific Division Office obtained the use of a type 650 IBM Electronic Digital Computer, with certain peripheral equipment, primarily for computation of system power studies for the Columbia River Basin. The streamflow routing technique was programmed for this type of computer, and the operation is entirely automatic, being controlled by proper sequencing of input values. In effect, when all storage constants have been evaluated, the program provides a model of the Columbia River System that can be used to represent streamflow for any specified meteorological or storage condition.

Sufficient storage routing constants were derived to test it on a day-to-day forecasting basis during the 1957 spring snowmelt flood. Forecasts made on 35 consecutive days helped to establish regulation of streamflow at reservoirs (primarily Grand Coulee Dam) for flood control operation on the main stem of the Columbia River. This trial showed that the method would perform as desired and that results would be available within prescribed time limitations.

Three types of storage delay to runoff must be evaluated in the Columbia River System:

1. Basin storage, whereby the streamflow at an upstream gaging station can be computed as a time-rate function from basin input values of rainfall or snowmelt excesses on the tributary areas.
2. Lake storage, resulting from the many large lakes in major tributaries, whose effects on streamflow may be evaluated by the basic reservoir-type storage equation.
3. Channel storage, which results from the natural delay of flow through segments of channels, known as "reaches."

Routing method

The program here described relies on a routing method which is derived from the general storage equation,

$$I_t = O_t + dS/dt \qquad (1)$$

where I_t and O_t are inflow and outflow, respectively, in cubic feet per second (cfs), and dS/dt is the rate of change of storage in the time, t. For cases where storage is a function of outflow (as in natural lakes, or for channel storage in short reaches where wedge storage is negligible in comparison with prismatic storage),

$$S = T_s O \qquad (2)$$

where T_s is the proportionality factor between storage and outflow. Differentiating Eq. 2 with respect to time,

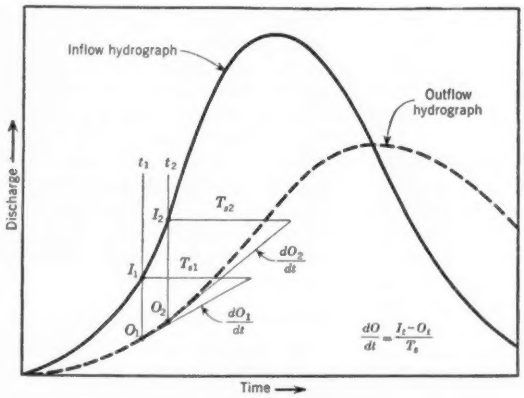
$$dS/dt = T_s\,(dO/dt) \qquad (3)$$

Substituting this expression in Eq. 1, it becomes

$$I_t = O_t + T_s\,(dO/dt)$$

$$\frac{dO}{dt} = \frac{I_t - O_t}{T_s} \qquad (4)$$

which represents the form of the storage equation used in this method. For natural lakes, the value of T_s is not con-



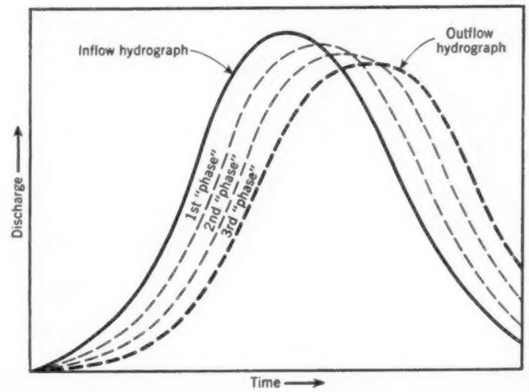


FIG. 1. (Above) Schematic representation of Eq. 4 shows how this equation can be used in the program to evaluate lake or reservoir storage, in small finite increments of time.

FIG. 2. (Above, right) Time delay from channel can be evaluated by successive routings (called "phases") through many small increments of reservoir-type storage.

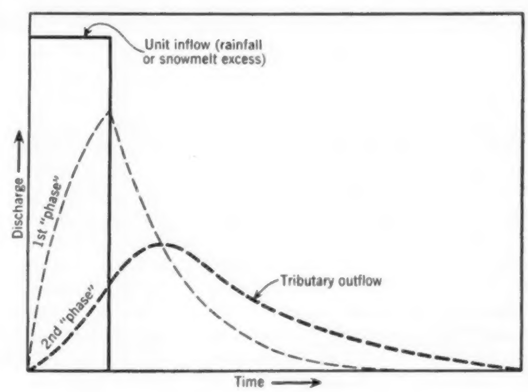


FIG. 3. (Right) Basin storage evaluation, by successive routings of a unit basin input, is shown schematically through two "phases" of reservoir-type storage.

stant, but it can be evaluated from the storage and outflow characteristics. This can be done by evaluating the differential of Eq. 2 with respect to h,

$$T_s = \frac{dS/dh}{dO/dh} \quad \text{. . . . .} \quad (5)$$

where T_s for a given elevation, h, is given in units of time, dS/dh represents the slope of the storage-elevation curve, and dO/dh is the slope of the discharge-elevation curve at elevation h. From Eq. 4 it can be shown that with zero inflow, the outflow recession is in the form

$$O_t = O_O\, e^{-t/T_s} \quad \text{. . . . . . .} \quad (6)$$

where O_O is the initial outflow at time, $t = 0$; O_t is the outflow at time, t; and T_s is the proportionality constant defined above, corresponding to the value of O_t. Equation 6 is the typical decay-type function characteristic of streamflow recession, but with a varying recession coefficient for this method.

When applied to natural lakes or reservoirs, Eq. 4 may be used in the program in small finite increments of time, as shown schematically in Fig. 1. The same general equation may be applied to channel storage by reducing the length of the channel reach to the point where "wedge" storage is negligible in comparison with "prismatic" storage.

By successive routings (here called "phases") through many small increments of reservoir-type storage, the time delay from channel storage can be evaluated as shown in Fig. 2. Similarly, basin storage can be evaluated through successive "phases" of reservoir type storage, to represent empirically the effect of basin storage. This distributes runoff from basin input values in inches per 6-hour period, which provides streamflow, in cfs, comparable to that obtained through the use of unit hydrographs. The storage routing method used here has the advantage of being able to adjust values to observed conditions on a day-to-day basis. The distribution of runoff by successive routings of a unit basin input, through two "phases" of reservoir-type storage, is shown schematically in Fig. 3.

An important feature of the routing method for basin and channel storage is that the time of storage can be varied with flow. This, in effect, results in distribution of runoff from snowmelt or rainfall excesses, which may be varied with the flow condition. For example, the time delay to runoff may be made shorter with high rates of runoff and longer with low rates of runoff. Similarly, the time of travel of flood waves through channels may be made to vary with discharge, according to channel conditions. This feature allows great flexibility in empirical fit of data from constants developed from actual record, and the method may be used to represent closely the actual time delay to runoff.

Basic codes and routines

The basic code comprises a set of instructions which directs the computation of streamflow from input data read from punch cards, through appropriate routing subroutines and summing routines. The three routing subroutines, for evaluating basin, channel, and lake storage, are based on evaluation of the storage equations as explained above. The subperiod time increment for each phase of routing is three hours. Constants, which are proportional to each of the storage times for each successive routing, are used and stored for each basin area or channel reach. To evaluate basin storage, inflow amounts are divided between surface (direct) and subsurface (groundwater) runoff, and each

component is routed separately through two phases of reservoir storage.

All necessary constants for basin, channel, and lake storage for the entire basin, together with the necessary programs and routines for the actual routing, are contained on a single loading of the storage drum of the IBM 650, which has storage capacity of 2000 ten-digit words. Sufficent space is reserved for obtaining outflow data for a 10-day forecast, with values of discharge given for four times per day (at 6-hour intervals).

There are 68 stream gaging locations or local inflow points on the Columbia and its tributaries for which discharge data can be obtained. Input cards may be read in for basins, with values given as snowmelt or rainfall excess in inches per 6-hour period, and output cards are punched to give values of streamflow in cfs for the stream gaging point. This operation is repeated successively downstream, and tributary inflows are added and routed through channel or lake storage to the downstream points. A set of "pilot" routines directs the operation from one reach to the next, and ties the entire routing into a completely automatic operation. Thus, successive inflows are routed and summed from the headwaters of the basin to the outflow for the Columbia River at The Dalles, Oreg., which defines the river stage in the lower Columbia River during periods of high slow. Inflows from the Willamette River and other minor tributaries below The Dalles are negligible during spring floods.

For a five-day forecast, flows for the entire basin can be routed in three-quarters of an hour of IBM 650 machine time. Figure 4 shows the upper part (above Grand Coulee) of the Schematic Master Flow Diagram for the Columbia River Basin, with the relative locations of the subbasin areas, major lake storages, and channel reaches at present incorporated in the program.

Input data

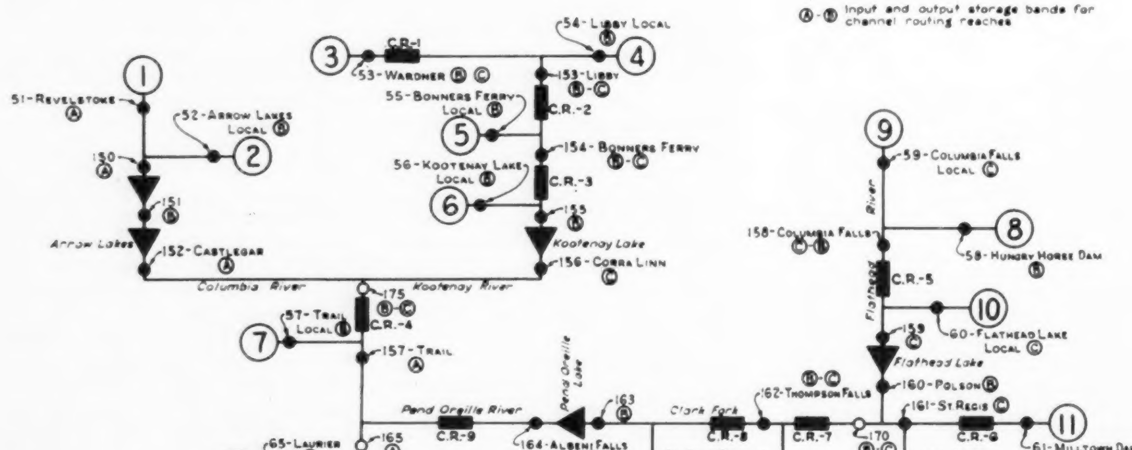
For any drainage basin or local ungaged area, inflows may be read in as basin runoff excesses resulting from snowmelt or rainfall, in inches per 6-hour period, or as basin outflows in cfs. In addition, it is possible to enter any tributary at one of the downstream gaging points, with given or assumed values of streamflow in cfs, without routing through the tributaries upstream from the control point. Thus it is possible to route flow in any section of the river from given natural or regulated flows at the upstream control points.

Snowmelt is computed from basin snowmelt indexes. For the 1957 trial operation, a simple maximum temperature index of snowmelt was used, with provision for an effectiveness factor to account for variations in albedo of the snow surface (ratio of reflected light to total light falling on the surface). Estimated or observed values of snow-cover area, in percentage of total drainage area at the gage, are required. Rainfall amounts, which may contribute to runoff during snowmelt floods, are estimated from network observations.

Supplementary routines

In addition to the main routing routine, with its subroutines and pilot routines, two supplementary routines were written which are entirely independent. These are for the purpose of reducing the time necessary for preparing a forecast. The first is the "distribution routine," used to distribute daily values of basin snowmelt or rainfall runoff excesses into 6-hour increments, according to a percentage pattern which may be changed with time. The second supplementary routine is used to plot outflows in cfs for the end of each 6-hour period,

FIG. 4. Streamflow routing diagram for IBM 650 is given for section of Columbia Basin above Grand Coulee, representing about one-third of the basin above The Dalles, Oreg.



in the form of hydrographs, on the IBM 402 tabulating machine.

This general description omits mention of the many details of programming and coding as well as the data processing techniques required to provide a workable solution in the limited time normally available for streamflow forecasting. The method described provides the framework for completely automatic determination of the components of streamflow in the Columbia River Basin, whereby all hydrometeorological factors affecting runoff can be evaluated objectively through cause and effect relationships. The method is feasible only with an electronic computer, but with the advent of such computers, it provides the hydrologist with a flexible and rapid means of synthesizing streamflow.

This procedure was developed under the general supervision of Mr. Mark L. Nelson, Head, Water Control Branch, U.S. Army Engineer Division, North Pacific. The writer wishes to acknowledge the work done by Mr. Edward M. Davis of that office in coding the basic program and supplementary routines, and for general aid in data processing techniques. His work contributed immeasurably to the successful completion of the procedure.

ENGINEERS' NOTEBOOK

Chart gives lengths of sight over highway crests

H. H. CORSON, M. ASCE Consulting Engineer, Birmingham, Mich.

The accompanying chart, Fig. 1, makes it possible to quickly determine the lengths of sight over highway crests afforded by parabolic vertical curves of various lengths. In my experience this chart has materially speeded up the laying out of highway grades for safer driving from the standpoint of lengths of sight afforded.

A similar chart which I prepared some years ago appeared in The Readers Write section of Civil Engineering for May 1935, p. 313. During the following two or three years I received about fifty letters from various members regarding this chart. It was prepared on the basis of a height of eye above the road of 5 ft.

During the intervening years automobile designers have so changed the heights of cars that this old chart is no longer of much use, the height of eye in modern cars being normally between 3.5 and 4 ft above the road. I have therefore recomputed and redrawn the chart basing it on a height of eye of 3.5 ft above the road, as here shown.

Example: Assume a plus 2 percent grade intersecting a minus 4 percent grade at the crest of a hill. The algebraic difference in grade is 6 percent.

If an 800-ft length of sight is desired, following the ordinate through the 6-percent difference at the bottom of the chart, up to its intersection with the 800-ft sight curve, will give a length of parabolic vertical curve of about 1,360 ft. This intersection will also show a vertex correction of a little over 10 ft. If the profile shows the ground surface to be 6 ft below the vertex, the cut will be about 4 ft.

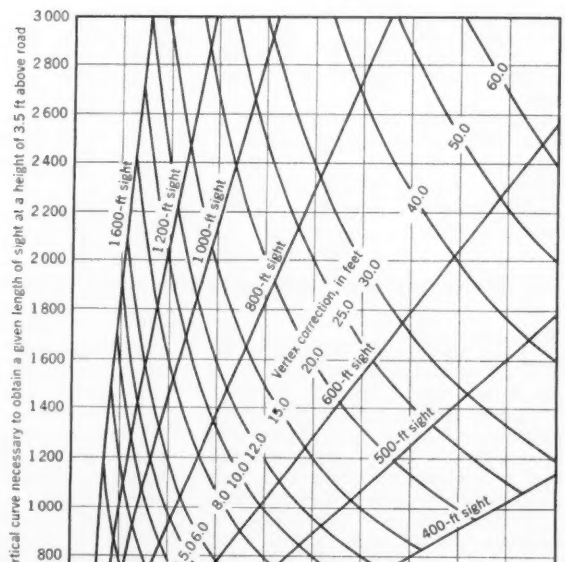


FIG. 1. Chart gives relations between parabolic vertical curves, vertex corrections, and lengths of sight afforded by vertical curves over crests at eye height of 3.5 ft above road.

Fifth year needed for engineering students

To THE EDITOR: The report of the Task Committee on Professional Education, in the February issue, p. 61, contains many useful and extremely interesting conclusions. Between the lines there is hidden a strong indictment of a considerable segment of the profession.

In a self appraisal there is little point in obscuring the basic facts: (1) civil engineering *at present* is one of the least promising branches of engineering, (2) students choosing civil engineering form a decreasing percentage with the years, and what is worse, tend with a few exceptions to be average students and not top-notch ones.

Why have we arrived at this deplorable state when civil engineering plays so indispensable a role and "demands quality and stature over and above the requirements of the analytical processes of scientific application?" Why when so many educated as civil engineers are now in the forefront of research work and in top administrative posts?

The answer is clear and lies in the attitude of the majority of civil engineering employers, both private and governmental. They seem to insist that a recent civil graduate:

1. Take a lower salary than is readily available in other branches of engineering.
2. Have a high degree of facility in many phases of engineering practice.
3. Do jobs that can be done as well or better by technicians.

Perhaps the fault lies also with those educators who either agree with or bow to this set of attitudes and meet the demand by turning out a graduate who is not as broadly based as a mechanical or electrical engineering student from their own school. Inclusion of many courses in details of practice must of necessity crowd out the essence of a liberal engineering education. Four years is barely enough to cover the essentials of mathematics, science, and engineering science, a reasonable grounding in the liberal arts, and a short introduction to design. These are the topics on which schools should concentrate because they lie at the heart of engineering and are so difficult to learn through experience alone. A fifth year reserved for the professional courses could overcome this difficulty but professional practice is best learned in a real and not an artificial situation.

Practicing engineers must take to heart the recommendation of the committee, "The growth and maturing of professional qualities must be stimulated by organizations employing civil engineers." They must pay appropriate salaries and treat recent graduates as intelligent and able engineers-in-training. We then shall be on the road to attracting large numbers of bright young men to our profession.

D. C. DRUCKER, M.ASCE
Chairman, Div. of Eng.
Brown University

Providence, R. I.

Some unprofessional practices need attention

To THE EDITOR: The Task Committee is to be complimented on the excellent job it has accomplished in surveying and presenting the facts on professional education. However, I would like to point out some related conditions common to civil engineers who earn their livelihood by working for corporations:

1. In many drafting rooms, engineers, designers, and draftsmen possess many different degrees of education and training (some have no formal education) yet all do the same work and earn the same money. One of two conclusions follows: (*a*) Either civil engineering work requires no formal education, or (*b*) management wastes the talents of the engineer by forcing him to do routine tasks.
2. Many corporations place unqualified men, who are not registered engineers, in charge of responsible engineering work. This practice indicates the necessity of revamping registration laws and providing for their proper enforcement.

That a man who fills an engineering job without proper qualifications is capable is beside the point. The fact remains that he has bypassed the recognized prerequisites of professional training. The medical profession will not tolerate the practice of medicine by any person who has not met the legal and educational requirements, no matter how capable he may be.

It should be clear that civil engineering cannot be a profession in the true sense while practices such as these are condoned and tolerated.

WILLIAM S. WALKER, A.M. ASCE
Structural Engineer

Pittsburgh, Pa.

Practicability of inverted footing questioned

To THE EDITOR: Mr. Rogers' inverted footing, described in your February issue (p. 76), is certainly ingenious. But even if the ground is ideally cohesive, contains few boulders, and has the same bearing value at both levels, I fear most engineers would prefer a flat bearing surface and the greater precision gained by the use of forms. Possible savings in such a footing are so small, compared to the value of the structure it would support! Lower stresses are desirable, but present allowable stresses seem abundantly safe.

I question the "conventional footing" to which Mr. Rogers compares his design. I believe the accompanying sketch,

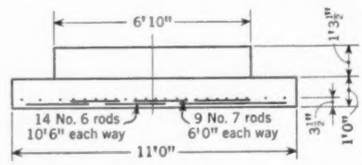


FIG. 1. "Representative" footing uses 80 percent of the concrete and 93 percent of the steel of inverted footing.

Fig. 1, using 80 percent of the concrete and 93 percent of the steel of Mr. Rogers' inverted footing, is more representative of footings of this size.

HENRY WILLCOX, M. ASCE

Norwalk, Conn.

Electronic bore-hole camera a personal enterprise

To THE EDITOR: We were very glad to see the article, "Electronic Bore-Hole Camera for TV Projection," by Klaus John, Senior Engineer-Analyst with Dames & Moore, soil mechanics engineers, which appeared in the March issue (p. 67).

We wish to point out that the article describes an instrument with which Mr. John became familiar before he came to the United States and before his employment by Dames & Moore. The partnership of Dames & Moore is in no way connected with the distribution of the electronic bore-hole camera, and the article does not imply our endorsement of the camera. Distribution of the camera is an outside personal activity of Mr. John.

VERNON A. SMOOTS, A.M.ASCE
Resident Partner, Dames & Moore,
Los Angeles

Los Angeles, Calif.

Portland Convention

Oregon Section Host

Hotel Multnomah, Portland, Oreg. **June 23-27, 1958**

REGISTRATION

Hotel Multnomah, Main Floor

Sunday, June 22, 1:00 p.m. to 6:00 p.m.
Monday through Thursday, 8:30 a.m. to 5:00 p.m.
Fee, $5.00. (Ladies $1.00. Students no charge.)
There is no advance registration.

INFORMATION

Information and registration facilities will be maintained on the main-floor lobby of Hotel Multnomah, Sunday, June 22, through Thursday, June 26. All messages will be held for members at the Information Desk.

ADVANCE INFORMATION ON ATTENDANCE

Please let us know your plans. Assist our Committee to prepare adequately to serve you by sending at once the coupon on page 149.

HOTEL ACCOMMODATIONS

Headquarters for the Portland Convention will be Hotel Multnomah. To the extent that rooms are available they will be assigned in the headquarters hotel on a first come, first served basis. A reservation request form for your convenience is provided on page 144. Please mail early.

LADIES HOSPITALITY ROOM

Hotel Multnomah

The Hospitality Room on the second floor of the Multnomah Hotel will be the rendezvous for all ladies attending the Convention. It will be open from 2:00 p.m. to 5:00 p.m. on Sunday, June 22, and from 9:00 a.m. to 5:00 p.m. each Convention day. Hostesses will be in attendance to welcome you, to help you meet the friend you have been looking forward to meeting once again, and to make new friends. Coffee will be served from 9:00 a.m. to 11:00 a.m. on Monday, Wednesday, and Thursday mornings. Card tables will be set up for those interested in playing.

AUTHORS' BREAKFASTS

Hotel Multnomah, Cameo Room

7:30 a.m. Monday through Friday

Briefing sessions for speakers, discussers and program officials for each day will take place at breakfast on the morning of the same day.

Presiding: Norbert Leupold, Chairman, Technical Program Committee.

By invitation only.

MONDAY MORNING JUNE 23

Hydraulics Division

9:00 a.m. Marine Room

Sponsored by Committee on Hydraulic Structures

Presiding: H. M. Martin, Chairman, Exec. Committee, and J. H. Douma, Chairman, Committee on Hydraulic Structures, Hydraulics Div.

9:00 High-Head Reservoir Control Gates

J. H. Douma, A.M. ASCE, Hydraulic Engr., Office of the Chief of Engineers, Washington, D. C.

9:30 Hydraulic Characteristics of Gate Slots

J. W. Ball, A.M. ASCE, Hydraulic Engr. Bur. of Reclamation, Denver, Colo.

10:00 Determination of Downpull Forces on Fixed Wheel Gates

Donald Colgate, A.M. ASCE, Hydraulic Engr., Bur. of Reclamation, Denver, Colo.

Discussion

C. D. Ramsden, Vice President and General Manager, Pacific Coast Eng. Co., Alameda, Calif.

10:45 Air Models as Tools for Determining Hydraulic Downpull on Large Gates

W. P. Simmons, Jr., A.M. ASCE, Hydraulic Engr. Bur. of Reclamation, Denver, Colo.

Discussion

Peter M. Smith, J. M. ASCE, Hydraulic Engr., Bonneville, Hydraulic Lab., Corps of Engineers, Bonneville, Oreg.

Pipeline Division

9:00 a.m. Emerald Room

Presiding: F. C. Culpepper, Member, Exec. Committee, Pipeline Div.

9:00 Pipeline Construction—Changes During the Past Thirty Years

J. W. Hall, M. ASCE, President, Hallmac Construction Co., Houston, Tex.

9:30 Westcoasts' Gathering System

A. L. Berry, Pipeline Engr., Westcoast Transportation Co. Ltd., Vancouver, B. C.

10:00 Gilsonite Solids Pipeline

E. F. Fulkerson, J. M. ASCE, and J. E. Rinne, M. ASCE, Standard Oil Co. of Calif., San Francisco.

10:30 The Scenic Inch

Color and sound film by Pacific Northwest Pipeline Corp. Film shows construction and operation of natural gas transmission system from production to ultimate consumption of gas.

Sanitary Engineering Division

9:00 a.m. Blue Room

Presiding: Richard R. Kennedy, Chairman, Exec. Committee, Sanitary Engineering Div.

9:00 Water Supply for Metropolitan Portland

H. Kenneth Anderson, M. ASCE, Chief Engr., Bur. of Water Works, Portland.

9:45 Relation of Forest Cover to Total Water Yield

Nedavia Bethlahmy, Pacific Northwest Forest and Range Exp. Sta., U. S. Forest Service, Portland.

10:30 Administration of Air Pollution Control Laws

Oregon:

Richard E. Hatchard, Chief, Air Pollution Control Sect., Oregon State Board of Health, Portland.

Washington:

C. David Gordon, Managing Director, Association of Washington Industries, Seattle, Wash.

Structural Division

9:00 a.m. Empire Room

Design Factors for Timber Structures

Presiding: T. K. May, Chairman, Committee on Wood, Structural Div.

9:00 **The Factor of Safety in Design of Timber Structures**
LYMAN W. WOOD, Engr., Forest Products Lab., U. S. Dept. of Agriculture, Madison, Wis.

9:45 **Statistical Approach to Working Stresses for Non-Stress Graded Lumber**
J. D. SNODGRASS, Associate Chief, Physical Research, Oregon Forest Products Research Center, Corvallis.

10:30 **Joint Fastenings**
RALPH H. GLOSS, A.M. ASCE, Vice President, Timber Engineering Co., Washington, D. C.

11:15 **Design Standards**
ROBERT E. EBY, A.M. ASCE, Chief Engr., Rilco Laminated Products, Inc., St. Paul, Minn.

Construction Division

9:00 a.m. Junior Ballroom

Presiding: Walter L. Couse, Vice Chairman, Exec. Committee, Construction Div.

9:00 **Columbia River Portland-Vancouver Interstate Bridge**
IVAN D. MERCHANT, A.M. ASCE, Bridge Engr., Oregon State Highway Dept.

9:45 **Planning Construction of Large Timber Structures**
ELON E. ELLIS, Vice-President, Timber Structures, Inc., Portland.

10:30 **Uniform Requirements of Contractor's Liability and Personal Property Insurance**
W. C. WILLIAMS, State Highway Engr., Oregon.

Soil Mechanics and Foundations Division

9:00 a.m. Rose Bowl

Presiding: Ralph E. Fadum, Chairman, Exec. Committee, Soil Mechanics and Foundations Div.

9:00 **Consolidated CBR Criteria**
C. R. FOSTER, A.M. ASCE, Chief, Flexible Pavement Branch, and R. B. AHLVIN, A.M. ASCE, Chief, Special Projects Sect., Soils Div., Waterways Exp. Sta., Vicksburg, Miss.

9:30 **A Study of an Earth Slope and Retaining Wall Problem**
WILLIAM ENKEBOLL, A.M. ASCE, Resident Partner, Dames and Moore, Seattle, Wash.

10:00 **Underseepage Control at Fort Randall Dam**
S. T. THORFINNSON, J.M. ASCE, Omaha District, Corps of Engineers, Omaha, Nebr.

10:30 **Measurement of Subsurface Deformations**
S. D. WILSON, A.M. ASCE, Shannon & Wilson, Seattle, Wash.

WELCOMING LUNCHEON

Monday, June 23

12:15 p.m. Grand Ballroom

Presiding: LOUIS R. HOWSON, President, ASCE

Speaker: HON. ROBERT D. HOLMES, Governor, State of Oregon.

All members, guests and friends of ASCE are cordially invited to attend this luncheon.

Tickets for this event must be purchased by 10:00 a.m. Monday.

MONDAY AFTERNOON JUNE 23

Hydraulics Division

2:00 p.m. Marine Room

Sponsored by Committee on Hydraulic Structures, Hydraulics Div.

Presiding: Harold M. Martin, Chairman, Exec. Committee, and J. H. Douma, Chairman, Committee on Hydraulic Structures, Hydraulics Div.

2:00 **High-Head Tainter Gates for Reservoir Outlets**
T. E. MURPHY, M. ASCE, Hydraulic Engr., Waterways Exp. Sta., Corps of Engineers, Vicksburg, Miss.

Discussion
A. P. GILDEA, A.M. ASCE, Hydraulic Engr., Los Angeles Dist., Corps of Engineers, Los Angeles, Calif.

2:45 **Reverse Tainter Lock Valves**
R. E. ELDER, M. ASCE, Director, TVA Hydraulic Lab., Norris, Tenn.

Discussion
G. C. RICHARDSON, A.M. ASCE, Hydraulic Engr., Walla Walla Dist., Corps of Engineers, Walla Walla, Wash.

3:30 **Problems Encountered in Use of Low-Head Radial Gates**
T. J. RHONE, A.M. ASCE, Hydraulic Engr., Bur. of Reclamation, Denver, Colo.

Discussion
M. L. DICKINSON, M. ASCE, Chief Hydraulic Engr., Bechtel Corp., Los Angeles, Calif.

Pipeline Division

2:00 p.m. Emerald Room

Presiding: R. E. Kling, Chairman, Committee on Programs, Pipeline Div.

2:00 **Engineer-Geologist Team Approach to Conduit Location Through Unusual Subsidence Area**
M. J. SHELTON, M. ASCE, Deputy Director, and L. B. JAMES, Chief Geologist, Calif. State Dept. of Water Resources, Sacramento.

2:40 **Pipeline Instrumentation—Remote Indication and Control**
MICHAEL D. ALTFILLISCH, Detroit Controls Corp., Norwood, Mass.

3:15 **Super Inch**
Color and sound film by Pacific Gas and Electric Co. Film shows 1600 miles of 34-in. natural gas pipeline constructed to line northern California and the gas fields of Texas and New Mexico.

3:50 **Pipeline Construction and Operation by Southern Pacific Railroad**
Supplemented by construction movie on line from Los Angeles to Phoenix. J. G. MONTFORT, J. M. ASCE, Pipeline Lines, Inc., Colton, Calif.

Power, Soil Mech. and Foundations and Constr. Divs., Joint Session

2:00 p.m. Rose Bowl

Presiding: J. F. Bonner, Vice Chairman, Exec. Committee, Power Div.

2:00 **The Paradela Concrete-Face Rockfill Dam and Comparison with Salt Springs Dam**
P. M. OLIVERIA REIZ, Hydro Electrica de Cavado, Portugal.

2:30 **The Lower Bear River Concrete-Face Rockfill Dams and Comparison with Salt Springs Dam**
I. C. STEELE, M. ASCE, Consulting Engr., San Francisco, Calif.

3:00 **Design and Construction of the Wishon and Courtright Concrete Face Rockfill Dams**
J. B. COOKE, M. ASCE, Supervising Civil Engr., Pacific Gas and Electric Co., San Francisco, Calif.

Sanitary Engineering Division

2:00 p.m. Blue Room

Presiding: Richard R. Kennedy, Chairman, Exec. Committee, Sanitary Engineering Div.

2:00 **Waste Disposal and Water Pollution Problems in the Willamette River Basin**
KENNETH H. SPIES, A.M. ASCE,

FAMILY BARBECUE

Monday Evening, June 23

Morelco Rancho, Oregon

Buses will leave Hotel Multnomah at 5:30 p.m.

Outdoor "get acquainted" barbecue for the family at Morelco Rancho, a private "oasis" nestled in the heart of the foothills of the Coast Range a few miles west of Portland in beautiful Tualatin Valley.

Deputy State Sanitary Engr., Oreg. State Board of Health, Portland.

2:30 A Tri-County Approach to Sewerage Problems in the Portland Metropolitan Area

Marvin W. Runyan, M. ASCE, James R. Boydston, J. M. ASCE, James A. Crom, Stevens & Thompson, Consulting Engineers, Portland.

3:00 Seattle Metropolitan Sewerage Plan

Roy W. Morse, A.M. ASCE, City Engr., Seattle, Wash.

3:30 Abatement of Air and Water Pollution by the Pulp and Paper Industry

Herman R. Amberg, A.M. ASCE, Research Specialist, Crown Zellerbach Corp., Camas, Wash.

Structural Division

2:00 p.m. Empire Room

Timber Buildings—Experience, Special Features and Erection

Presiding: Robert D. Dewell, Member, Exec. Committee, Structural Div.

2:00 Glued Laminated Construction in Europe

M. L. Selbo, Chemical Engr., Forest Products Lab, U. S. Dept. of Agriculture, Madison, Wis., and A. C. Knauss, Technologist, Forest Utilization Research, U. S. Dept. of Agriculture, Portland.

2:45 Wood Diaphragms

Henry J. Degenkolb, M. ASCE, Partner, Gould & Degenkolb, Consulting Engineers, San Francisco, Calif.

3:30 Timber Arches and Trusses

Frank J. Hanrahan, M. ASCE, Executive Vice-President Amer. Inst. of Timber Construction, Washington, D. C.

4:15 Timber Trusses, Erection and Bracing

C. H. Anderson, A.M. ASCE, Chief Engr., Timber Structures, Inc., of Calif., Richmond, Calif.

TUESDAY MORNING JUNE 24

Construction Division

9:00 a.m. Junior Ballroom

Presiding: Lyman D. Wilbur, Vice President, Morrison-Knudsen Co., Inc., Boise, Idaho

9:00 Legal Pitfalls Involved in Construction and Methods of Eliminating These in Proper Planning and Construction Management

Roy Scheufele, Exec. Asst. to Div. Engr., Corps of Engineers, Portland.

9:45 Estimating Construction Costs of Water Resource Development Projects

E. K. Wilkins, Vice President, Ebasco Services, Inc.

Hydraulics Division

9:00 a.m. Marine Room

Sponsored by Committee on Hydromechanics, Hydraulics Division

Presiding: Harold M. Martin, Chairman, Exec. Committee, and D. R. F. Harleman, Chairman, Committee on Hydromechanics, Hydraulics Div.

9:00 Friction Factors in Corrugated Metal Pipe

Lawrence R. Metcalf, A.M. ASCE, Hydraulic Engr., and Marvin J. Webster, A.M. ASCE, Head, Hydraulic Sect., Corps of Engineers, Portland.

9:45 Facilities and Current Research Program at the R. L. Albrook Hydraulic Laboratory

E. Roy Tinney, J.M. ASCE, Head, the R. L. Albrook Hydraulic Lab., Washington State Inst. of Tech., Pullman, Wash.

10:30 Hydraulic Model Tests for Design of Priest Rapids Fish Facilities

Lorenz G. Straub, M. ASCE, Director, St. Anthony Falls Hydraulic Lab., Univ. of Minnesota, Minneapolis, Minn.

Sanitary Engineering Division

9:00 a.m. Blue Room

Presiding: Richard R. Kennedy, Chairman, Exec. Committee, Sanitary Engineering Div.

9:00 Water Resources Problems and Development of Oregon

Fred Merryfield, M. ASCE, Prof. of Sanitary Eng., Oregon State College, Corvallis.

9:30 The Alsea Basin Study

R. E. Dimick, Head, Dept. of Fish and Game Management, Oregon State College, Corvallis; and Don R. Chapman, Project Supervisor, Alsea Basin Study, Committee on Natural Resources, Salem, Oreg.

10:00 Water Quality Problems of the Columbia River

Herbert C. Claire, M. ASCE, Asst. Regional Engr., Water Supply and Water Pollution Control, Pacific N. W. Basin, Public Health Service, Portland.

Soil Mechanics and Foundations Division

9:00 a.m. Empire Room

Presiding: Stanley J. Johnson, Vice Chairman, Exec. Committee, Soil Mechanics and Foundations Div.

9:00 Swift Hydroelectric Project

E. R. deLuccia, M. ASCE, Vice President and Chief Engr., Pacific Power and Light Co., Portland; and John R. Kiely, M. ASCE, Senior Vice President, Bechtel Corporation, San Francisco, Calif.

9:30 Swift Dam Design

James G. Patrick, A.M. ASCE, Project Engr., Bechtel Corporation, Vernon, Calif.

10:00 Swift Dam Construction

Harris H. Burke, M. ASCE, Asst. Resident Engr., Bechtel Corporation, Cougar, Wash.

FIELD TRIPS

June 24

Lumber Industry Processing Plants, Longview, Wash.

Sponsored by Structural Division and West Coast Lumbermen's Association

Departure: 8:15 a.m. from Hotel Multnomah by bus.

Return: 5:00 p.m. to Hotel Multnomah by bus.

Forty miles down river from Portland is the planned City of Longview, Wash., site of the lumber and pulp plants of Weyerhaeuser Timber Co. and the International Paper Co., some of the largest in the world. Trip will be across Interstate Bridge to Vancouver, Wash., then west and north on U. S. Highway 99 paralleling Columbia River. Lunch in Longview.

Registration: At the Convention registration desk no later than 5:00 p.m., Monday, June 23.

Swift Creek Dam

Sponsored by Soil Mech. and Foundations, Construction, and Power Divisions

Departure: 11:45 a.m. bus leaves from Hotel Multnomah. Box lunch served on bus.

Return: 5:00 p.m. to Hotel Multnomah.

Swift Creek Dam, of Pacific Power & Light Co., will require 15 million cu yd of earth for its world-record height of 512 ft. All construction operations will be in progress; first of its 204,000-kw power is scheduled for late fall.

Water Supply Headworks

Sponsored by Sanitary Eng. Division

Departure: 1:15 p.m. from Hotel Multnomah by bus.

Return: 5:00 p.m. to Hotel Multnomah by bus.

Bull Run Reserve is the source of water for the "City of Roses," set aside as a Reserve by Act of Congress. First contract for Bull Run Dam No. 2 is under way, consisting of diversion tunnels and intake and outlet structures.

R. H. Baldock Freeway

Sponsored by Highway Division

Departure: 1:30 p.m. from Hotel Multnomah by bus.

Return: 4:30 p.m. to Hotel Multnomah by bus.

Construction of last link of Freeway from Salem to Harbor Drive Expressway leading to downtown Portland, named in honor of R. H. Baldock, M. ASCE, long-time Chief Highway Engr., Oregon State Highway Dept.

Bonneville Hydraulics Lab., Corps of Engineers

Sponsored by Hydraulics Division

Departure: 1:30 p.m. from Hotel Multnomah by bus.

Return: 5:00 p.m. to Hotel Multnomah by bus.

City of Salem and American Pipe and Construction Co. Pipe Plant

Sponsored by Pipeline Division

Departure: 8:30 a.m. from Hotel Multnomah by bus. Arrive 9:00 a.m. at American Pipe and Construction Co. plant for inspection of pipe manufacturing process. Arrive 12:00 noon at Stayton Island, for barbecue lunch. From 1:00 to 3:45 p.m., inspection of pipeline and water intake facilities, City of Salem, Oreg.

Return: 5:15 p.m. to Hotel Multnomah by bus.

PIPELINE DIVISION DINNER

Tuesday, June 24

7:00 p.m. Empire Room

Speaker: Eldon V. Hunt, Chairman, Exec. Committee, Pipeline Div.; Chief Engr., Alberta Gas Trunk Line Co., Ltd.

Subject: The Provincial, Inter-Provincial and International Character and Position of the Alberta Gas Trunk Line.

Tickets must be purchased by 3:00 p.m., Tuesday, June 24.

WEDNESDAY MORNING JUNE 25

General Session

9:00 a.m. Empire Room

Presiding: Louis R. Howson, President ASCE.

Welcome to Portland: Terry D. Schrunk, Mayor, City of Portland.

Response: Mr. Howson

Annual Address: Louis R. Howson, President, ASCE.

Dept. of Conditions of Practice

Presiding: Norman R. Moore, Vice President, ASCE; Chairman, Dept. of Conditions of Practice

9:45 **Unity in the Engineering Profession**

T. Carr Forrest, M. ASCE, Past-President, NSPE, Forrest & Cotton, Dallas, Tex.

10:15 **Unity in the Engineering Profession through EJC**

Mason G. Lockwood, Past-President, ASCE, Lockwood, Andrews & Newnam, Houston, Tex.

10:45 **General Discussion on the Need for and Means of Attaining Unity in the Engineering Profession**

GENERAL MEMBERSHIP LUNCHEON

Wednesday, June 25

12:15 p.m. Grand Ballroom

Presiding: H. Loren Thompson, General Chairman, Portland Convention

Speaker: F. C. Lindvall, President, American Society for Engineering Education.

Subject: Engineering Education as It Affects Unity in the Profession of Engineering.

All members, their ladies, guests and friends of ASCE are urged to attend. Tickets for this luncheon must be purchased by 10:00 a.m. on Wednesday.

WEDNESDAY AFTERNOON JUNE 25

Department of Conditions of Practice

2:00 p.m. Cameo Room

Presiding: Samuel B. Morris, Vice-President, ASCE.

2:00 **The Civil Engineer and Public Relations**

A. W. Priaulx, Public Relations Director, West Coast Lumberman's Association.

2:30 **The Road to Professional Responsibility**

Elbert Rice, A.M. ASCE, Prof. of Civil Engr., Univ. of Alaska, College, Alaska.

3:00 **Pity the Poor Professors?? Or Propagate Them!!**

Jack McKee, M. ASCE, Prof. of Sanitary Engr., Calif. Inst. of Technology, Pasadena, Calif.

Hydraulics Division

2:00 p.m. Marine Room

Sponsored by Committee on Tidal Hydraulics

Presiding: Harold M. Martin, Chairman, Exec. Committee, and Eugene P. Fortson, Chairman, Committee on Tidal Hydraulics, Hydraulics Div.

2:00 **Interim Consideration of the Columbia River Entrance**

John B. Lockett, North Pacific Div., Corps of Engineers, Portland.

2:30 **Salt Routing in Six Hundred Miles of Sacramento-San Joaquin Delta Channels by Digital Computer**

Herbert A. Howlett, A.M. ASCE, and Don H. Nance, Calif. Dept. of Water Resources, Sacramento, Calif.

3:30 **Use of Tri-Linear Diagrams in the Study of Sea Water Intrusion in Multiple Estuary Channels**

Wayne Macrostie, A.M. ASCE, Hydraulic Engr., Calif. Dept. of Water Resources, Sacramento, Calif.

Irrigation and Drainage Division

2:00 p.m. Emerald Room

Water Planning on a Statewide Basis

Presiding: Kenneth Q. Volk, Member, Exec. Committee, Irrigation and Drainage Div.

2:00 **Impacts of Upstream Irrigation Development on Downstream Regimen of Columbia River**

Harold T. Nelson, Director, Region 1, Bur. of Reclamation.

2:45 **Statewide Water Planning**

HARVEY O. BANKS, M. ASCE, Director, Div. of Water Resources, Sacramento, Calif.

3:30 **Irrigation Problems in the Hawaiian Islands**

LOUIS H. HERSCHLER, Engr.-Director, Hawaii Water Authority, Honolulu.

Pipeline, Surveying and Mapping Divs., Joint Session

2:00 p.m. Junior Ballroom

Presiding: E. V. Hunt, Chairman, Exec. Committee, Pipeline Div.

2:00 **As Railroads Enter the Pipeline Business, Pipeline Engineers Face New Problems**

E. H. SCHMIDT, E. H. SCHMIDT and Associates, Inc., Tulsa, Okla.

2:40 **Photogrammetry Aids Pipeline Surveys**

A. O. QUINN, Chief Engr., Aero Service Corp., Philadelphia, Pa.; and EION E. DANDO, Western Manager, Aero Service Corp., San Francisco, Calif.

3:10 **Gas Goes to Market**

Color and sound film by Tennessee Gas Transmission Co., showing construction and operation of a natural gas pipeline system from the Gulf Coast of Texas and Louisiana to the Appalachian markets.

3:45 **Twenty Miles of Surveying for the 54-Inch Salem Water Line**

WARREN W. CLARK, Clark and Groff, Engineers, Salem, Oreg.

4:15 **Profiling Through Photogrammetry**

JOHN D. BAYLESS, Sales Manager of Abrams Aerial Survey Corp., Lansing, Mich.

Soil Mech. and Foundations, Power, Construction Divs., Joint Session

2:00 p.m. Rose Bowl

Presiding: Ralph B. Peck, Member, Exec. Committee, Soil Mechanics and Foundations Div.

2:00 **Performance of Cogswell (San Gabriel No. 2) Concrete Face Rockfill Dam and San Gabriel (No. 1) Center Core Rockfill Dam**

PAUL BAUMANN, M. ASCE, Asst. Chief Engr., Los Angeles County Flood Control Dist., Los Angeles, Calif.

2:30 **Performance and Maintenance Foundation Grouting of Dix River Concrete-Face Rockfill Dam**

LEWIS A. SCHMIDT, JR., M. ASCE, Consulting Engr., Chattanooga, Tenn.

3:00 **Design and Construction of Brownlee Sloping-Core Rockfill Dam**

T. MUNDAL, M. ASCE, Vice-President and Chief Engr., International Eng. Co., San Francisco, Calif.

3:30 **Performance of Kenney Sloping-Core Rockfill Dam and Design and Construction of Cheakamus and Mission Dams in British Columbia**

W. G. HUBER, M. ASCE, Consulting Engr., Vancouver, B. C., Canada.

HYDRAULICS DIVISION DINNER

Wednesday, June 25

At New Home of Oregon Museum of Science and Industry

Buses leave Hotel Multomah at 6:30 p.m.

7:00 p.m. Buffet Dinner: Broiled Columbia River Salmon

Presiding: HAROLD M. MARTIN, Chairman Exec. Committee, Hydraulics Div.

Speaker: SAMUEL B. MORRIS, Vice President, ASCE.

Dinner sponsored by the Hydraulics Division and Oregon Museum of Science and Industry to honor J. C. Stevens, Past President, ASCE, a founder of the Hydraulics Division, ASCE, and first president of the Oregon Museum of Science and Industry. OMSI will dedicate a room in their new home as The J. C. Stevens Hall of Hydromechanics.

Tickets must be purchased by 3:00 p.m. on Wednesday.

Structural and Highway Divisions, Joint Session

2:00 p.m. Empire Room

Presiding: Glenn Holcomb, Chairman, Dept. of Civil Eng., Oregon State College, and Elmer K. Timby, Member, Exec. Committee, Structural Div.

2:00 **Inspection Techniques for Control of Welding**

JOHN L. BEATON, A.M. ASCE, Supervising Highway Engr., Calif. Div. of Highways, Sacramento.

2:30 **Use of Models in Highway Planning**

F. B. CRANDALL, A.M. ASCE, Traffic Engr., Oregon State Highway Dept., Salem.

The Morrison Street Bridge in Portland

3:00 **General Planning**

R. M. BONNEY, A.M. ASCE, Partner, Moffatt, Nichol and Taylor, Consulting Engineers, Portland.

3:45 **River Spans**

JOHN I. PARCEL, HON. M. ASCE, Vice President, Sverdrup and Parcel, St. Louis, Mo.

4:15 **Construction**

RAYMOND D. BANE, M. ASCE, Project Engr., Sverdrup and Parcel, Portland.

THURSDAY MORNING JUNE 26

Hydraulics Division

9:00 a.m. Marine Room

Presiding: Harold M. Martin, Chairman, Exec. Committee, and Alvin G. Anderson, Chairman, Committee on Sedimentation, Hydraulics Division

9:00 **Rate of Growth and Location of Delta Formations**

A. S. HARRISON, J.M. ASCE, Chief of the Hydraulics and Sediment Sect., Omaha Dist., Corps of Engineers, Omaha, Nebr.

9:30 **Analytical Study of Alluvial Channel Roughness**

HSIN-KUAN LIU, A.M. ASCE, Asst. Prof. of Civil Eng., Colorado State Univ., Fort Collins.

10:00 **Laboratory Studies to Determine Cover Blanket for Kennewick Canal, Washington**

E. J. CARLSON, M. ASCE, Hydraulic Engr., Bur. of Reclamation, Denver, Colo.

Irrigation and Drainage Division

9:00 a.m. Cameo Room

Methods of Increasing and Conserving State Water Supplies

Presiding: Howard T. Critchlow, Chairman, Executive Committee, Irrigation and Drainage Div.

How to Reap Added Runoff From Watersheds

JOE ARNOLD, Watershed Management Div., Arizona State Land Dept., State Office Building Annex, Phoenix, Ariz.

Monthly Consumptive Use Requirements, Irrigated Crops

Harry F. Blaney, M. ASCE, Principal Irrigation Engr., Div. of Irrigation, Soil Conservation Service, Los Angeles, Calif.

Use of Electronic Computers in Water Resources Engineering

Robin Reynolds, A.M. ASCE, Supervising Hydraulic Engr., Dept. of Water Resources, State of Calif., Sacramento.

Ground Water Extraction and Land Subsidence Problem—San Joaquin Valley

J. F. Poland and G. H. Davis, Research Geologists, Ground Water Branch, U.S.G.S., Sacramento, Calif.

Power, Soil Mech. and Foundations, Construction Divs., Joint Session

9:00 a.m. Rose Bowl

Presiding: R. A. Sutherland, Member, Exec. Committee, Power Div.

9:00 **Nantahala, Bear Creek and Other Alcoa Sloping-Core Rockfill Dams**

James P. Growdon, M. ASCE, Consulting Engr., Pittsburgh, Pa.

9:30 **Bersimis Sloping-Core Rockfill Dam**

F. W. Patterson and D. H. MacDonald, H. G. Acres and Co., Niagara Falls, Canada.

10:20 **Performance of Mud Mountain Central-Core Rockfill Dam**

A. S. Cary, M. ASCE, Corps of Engineers, U. S. A., Portland.

Structural Division

9:00 a.m. Colonial Room

Timber Bridges on Railroads and Highways

Presiding: George S. Vincent, Vice Chairman, Exec. Committee, Structural Div.

9:00 **Timber Bridges on the Railways**

C. V. Lund, Asst. to Chief Engr., Chicago, Milwaukee, St. Paul and Pacific Railroad Co., Chicago, Ill.

9:45 **Timber Highway Bridges**

E. L. Erickson, Chief, Bridge Design Div., Bur. of Public Roads, Washington, D. C.

10:30 **Cumulative Stresses and Fatigue of Railroad Timber Bridge Stringers**

F. P. Drew, A.M. ASCE, Engr. Research Center, Assoc. of American Railroads, Chicago, Ill.

11:45 **Wood Preservation**

C. Miles Burpee, Exec. Director, American Wood Preservers Inst., Chicago, Ill.

Surveying and Mapping Division

9:00 a.m. Blue Room

Presiding: Carl M. Berry, Chairman, Exec. Committee, Surveying and Mapping Div.

9:00 **Surveying and Mapping Operations at Cougar Reservoir Project**

Charles N. Oros, Chief of Photogrammetry Sect., U. S. Army Engineer Dist., Portland.

9:30 **Comparison of Methods of Photogrammetric Mapping in Areas of High Relief**

Claude W. Waggoner, Chief of Survey and Drafting Branch, U. S. Army Engineer Dist., Walla Walla, Wash.

Northern Pacific Railway Relocation, Eagle Gorge Dam Project

10:00 **Engineering and Preconstruction Surveys**

William Inhelder, Chief of Survey Branch, Eng. Div., U. S. Army Engineer Dist., Seattle, Wash.

Construction Surveys (with colored slides)

Louis J. Zumek, Field Engr., Eagle Gorge Dam, U. S. Army Engineer Dist., Seattle, Wash.

Waterways and Harbors Division

9:00 a.m. Junior Ballroom

Sponsored by Committee on Navigation and Flood Control Facilities

Presiding: Joe W. Johnson, Member, Exec. Committee, Waterways and Harbors Div.

9:00 **Design Study of Vertical-Lift Lock Gate, Ice Harbor Dam**

Edmund H. Chun, A.M. ASCE, Supervising Structural Engr., and Howard M. Rigler, Chief Structural Design Sect., U. S. Army Engineer Dist., Walla Walla, Wash.

9:30 **Hydraulic Design of Columbia River Basin Navigation Locks**

George C. Richardson, A.M. ASCE, Chief, Hydraulic Design Sect., U. S. Army Engineer Dist., Walla Walla, Wash.; and Marvin J. Webster, M. ASCE, Chief, Hydraulic Sect., U. S. Army Engineer Dist., Portland.

10:00 **Navigation on the Columbia River**

Ray E. Holmes, Chief, Rivers and Harbors Sect., U. S. Army Engineer Dist., Portland.

GENERAL MEMBERSHIP LUNCHEON

Sponsored by Power, Soil Mechanics and Foundations and Construction Divs.

Thursday, June 26

12:15 p.m. Grand Ballroom

Presiding: Ralph E. Fadum, Chairman, Executive Committee, Soil Mechanics and Foundations Division

All members and their guests are cordially invited to attend. Tickets must be purchased by 10:00 a.m. Thursday.

THURSDAY AFTERNOON JUNE 26

Irrigation and Drainage Division

2:00 p.m. Cameo Room

Underground Reservoir Replenishment and Extraction

Presiding: William W. Donnan, Secretary, Exec. Committee, Irrigation and Drainage Div.

2:00 **Water Spreading for Municipal and Irrigation Use**

Kenneth Q. Volk, M. ASCE, Consulting Engr., Los Angeles, Calif.

2:30 **Financing Ground-Water Replenishment by Acre-Foot Charge for Water Extracted**

Howard Crooke, Mgr., Orange County Water Dist., Santa Ana, Calif.

3:00 **Modern Well Drilling Methods, Standard Rigs, Rotary Rigs, Perforation, Gravel Packing, Developing and Testing**

Roscoe Moss, Jr., Partner, Roscoe Moss Co., Los Angeles, Calif.

3:45 **Hydraulic and Electrical Model Approach to a Ground-Water Problem**

Kenneth Wright, A.M. ASCE, Hydraulic Engr., Div. of Project Investigation, Bur. of Reclamation, Denver, Colo.

Highway Division

2:30 p.m. Junior Ballroom

Symposium on Allocation of Cost Study, Section 210 of Federal Aid Highway Act of 1956

Presiding: Ralph Moyer, Research Engr., Inst. of Transportation and Traffic Eng., Univ. of Calif., Berkeley

2:30 **Background and General Outline of Study**

G. P. St. Clair, Bur. of Public Roads, Washington, D. C.

3:00 **Benefit Evaluation**

Robert Hennes, M. ASCE, Prof. of Civil Eng., Univ. of Washington.

3:30 **Inventory of Highway Needs**

Robert C. Blensly, J.M. ASCE, Planning Survey Engr., Oregon State Highway Dept., Salem.

4:00 **Vehicle Weight Study**

C. K. Glaze, Planning Engr., Washington Dept. of Highways, Olympia.

4:30 **Economic Impact and Questions That Will be Raised**

Richard Zettel.

Power, Soil Mech. and Foundations, Construction Divs., Joint Session

2:00 p.m. Rose Bowl

Presiding: T. M. Leps, Member, Exec. Committee, Soil Mechanics and Foundations Div.

2:00 **Design of Cougar Central-Core Rockfill Dam**

Paul Thurber, M. ASCE, Corps of Engineers, U. S. Army, Portland.

2:30 **Design and Construction of Derbendi Khan Central-Core Rockfill Dam, Iraq**

Calvin Davis, M. ASCE, President, Harza Engineering Co., Chicago, Ill.

3:00 **Construction and Performance of Kajakai Central-Core Rockfill Dam, Afghanistan**

G. F. Sudman, M. ASCE, Chief Design Engr., International Engineering Co., San Francisco, Calif.

3:30 **Construction and Performance of Cherry Valley Central-Core Rockfill Dam**

H. E. Lloyd, M. ASCE, Manager and Chief Engr., Hetch-Hetchy Water and Power Dept., City of San Francisco, Calif.

Hydraulics and Waterways and Harbors Divs., Joint Session

2:00 p.m. Marine Room

Presiding: H. Alden Foster, Chairman, Committee on Flood Control, Hydraulics Div.

2:00 **General Plan for Columbia Basin Flood Control**

Louis H. Foote, M. ASCE, Brig. Gen., U.S. Army, Ret'd., Forest Grove, Oreg.

2:30 **Application of Snow Hydrology to the Columbia Basin**

Oliver A. Johnson, M. ASCE, Hydraulic Engr., and Peter B. Boyer, Hydraulic Engr., U. S. Army Engineer Dist., Portland.

3:00 **A Digital Computer Technique for Streamflow Routing in the Columbia River Basin**

David M. Rockwood, A.M. ASCE, Hydraulic Engr., U. S. Army Engineer Dist., North Pacific Div., Portland.

Structural Division

2:00 p.m. Colonial Room

Small and Large Timber Buildings and Fire Protection

Presiding: Myle J. Holley, Jr., Secretary, Exec. Committee, Structural Div.

2:00 **Light Wood Trusses**

R. F. Luxford, Engr., Forest Products Lab., U. S. Dept. of Agriculture, Madison, Wis.

2:45 **Portland's Exposition-Recreation Center**

Guy H. Taylor, M. ASCE, Partner, Moffatt, Nichol & Taylor, Consulting Engineers, Portland.

3:30 **Structural Fire Endurance and Timber Construction**

H. E. Thompson, Fire Research Engr., Canadian Inst. of Timber Construction, Ottawa, Ont., Canada.

4:15 **Fire Retardant Coatings and Treatments for Wood**

C. J. Koskinan, Exec. Engr., Underwriters Labs., Inc., Santa Clara, Calif.

Surveying and Mapping Division

2:00 p.m. Blue Room

Presiding: Carl M. Berry, Chairman, Exec. Committee, Surveying and Mapping Div.

2:00 **Progress and Program Development of Topographic Mapping in the United States**

Roy F. Thurston, Ass't. Regional Engr., Pacific Region, U. S. Geological Survey.

2:30 **The Responsibility of the State Toward Surveying and Mapping**

Burton R. Ingalls, J.M. ASCE, Chief of Bur. of Surveys and Maps, Washington State Dept. of Natural Resources.

3:00 **Highway and Bridge Surveys on the Washington Lambert System**

Leo W. Eason II, Geodetic Engr., Washington State Highway Dept.

3:30 **The Tellurometer as a Practical Survey Instrument**

Kendall B. Wood, K. B. Wood and Associates, Inc.

DINNER DANCE AND ENTERTAINMENT

Thursday Evening, June 26
Hotel Multnomah

6:30 p.m. Social Hour, Empire Room

7:15 p.m. Dinner and Music, Grand Ballroom

Entertainment

Dancing

Dress informal.

FRIDAY MORNING JUNE 27

Highway Division

9:30 a.m. Marine Room

Symposium on Spacing and Location of Interchanges on Freeways in Urban and Suburban Areas

Presiding: Wilson T. Ballard, President, Wilson T. Ballard Co., Baltimore, Md.

Panel:

Edward T. Telford, M. ASCE, Asst. State Highway Engr., Calif. Div. of Highways, Los Angeles.

R. H. Kenyon, Chief Engr. of Plans, Washington Dept. of Highways, Olympia, Wash.

Jack Leisch, A.M. ASCE, De-Leuw, Cather & Co., Chicago, Ill.

W. S. Pollard, Jr., A.M. ASCE,

Chief Engr., Harland Bartholomew & Assocs., St. Louis, Mo.

Irrigation and Drainage Division

9:00 a.m. Emerald Room

Drainage by Surface Drains and Pumps

Presiding: Kenneth Q. Volk, Member, Exec. Committee, Irrigation and Drainage Div.

9:00 **Drainage of Agricultural Lands Using Interceptor Drains**

William W. Donnan, A.M. ASCE, Agricultural Engr., Soil and Water Conservation, Research Div., U. S. Dept. of Agriculture, Pomona, Calif.

9:30 **Laboratory Research on Interceptor Drains**

A. R. Robinson, Jr., M. ASCE, Irrigation Engr., U. S. Dept. of Agriculture, Ft. Collins, Colo., and Jack Kellar, W. R. Ames Co., Denver, Colo.

10:15 **Drainage Problems, Columbia River Basin, Water Application and Removal**

Francis C. Hart, A.M. ASCE, Regional Drainage Engr., U. S. Bur. of Reclamation, Boise, Idaho.

Waterways and Harbors Division

9:00 a.m. Junior Ballroom

Sponsored by Committee on Research

Presiding: Joe W. Johnson, Member, Exec. Committee, Waterways and Harbors Div.

9:00 **Forces Induced on a Large Moored Aircraft Carrier by Winds**

J. T. O'Brien, A.M. ASCE, Director, Waterfront Structures Div., and R. E. Jones, Hydraulic Engr., U. S. Naval Civil Eng. Research and Evaluation Lab., Pt. Hueneme, Calif.

9:30 **Breaking Wave Force Prediction**

R. L. Wiegel, Assoc. Research Engr., and R. E. Skjei, Geologic Engr., Inst. of Eng. Research, Univ. of Calif., Berkeley.

10:00 **Electric Analog Model of Sacramento-San Joaquin Delta**

H. A. Einstein, M. ASCE, Hydraulic Engr., and James A. Harder, Hydraulic Engr., Univ. of Calif., Berkeley.

10:30 **Use of Model Studies in Design and Construction of a Columbia River Multiple-Purpose Project**

Alvin J. Chanda, Bonneville Hydraulic Lab., Corps of Engineers, U. S. Army Engineer Dist., Portland.

Max F. Wehrly, Urban Land Inst., Washington, D. C.

Marvin Springer, Director of Planning, City of Dallas, Tex.

Power, Soil Mech. and Foundations, Construction Divs., Joint Session

9:00 a.m. Rose Bowl

Presiding: E. Robert de Luccia, Vice-President and Chief Engineer, Pacific Power and Light Co., Portland, Oreg.

9:00 **Performance of Watauga, South Holston, and Nottely Central-Core Rockfill Dams**

George K. Leonard, M. ASCE, Chief Engr., Tenn. Valley Authority, Knoxville, Tenn.

9:30 **Design and Construction of The Dalles Rockfill Closure**

R. J. Pope, M. ASCE, Corps of Engineers, U. S. Army, Portland.

10:00 **Rockfill Dams, Review and Statistics**

John B. Snethlage, M. ASCE; F. W. Scheidenheim, M. ASCE; and Arthur N. Vanderlip, M. ASCE, Consulting Engineers, New York, N. Y.

WOMEN'S PROGRAM

Monday, June 23

"Get Acquainted" Brunch, 11:00 a.m. Aero Club's Aerodrome.

"Get Acquainted" Barbecue for the family at Morelco, a private ranch. Entertainment. Buses leave Multnomah Hotel at 5:30 p.m.

Tuesday, June 24

Bus trip to Mt. Hood, tour, and luncheon at Timberline Lodge. Entertainment, snow cat, ski-lift.

Wednesday, June 25

Luncheon with husbands, 12:15 p.m., Grand Ballroom.

Tour of Portland by private buses. 2:15 p.m. followed by teas in private homes.

Thursday, June 26

Time provided for shopping, etc.

Informal Dinner Dance in evening.

PACIFIC NORTHWEST CONFERENCE, ASCE LUNCHEON

Friday, June 27

12:15 p.m. Empire Room

Presiding: Glenn H. von Gunten, President, Pacific Northwest Conference, ASCE.

This is a business session and luncheon of the Pacific Northwest Conference, ASCE. Members and their guests are cordially invited to attend.

FRIDAY FIELD TRIP

The Dalles Dam

Sponsored by Corps of Engineers, Portland District

Departure: 11:30 a.m. from Hotel Multnomah by bus.

Lunch: 12:30 p.m., at Multnomah Falls, 30 miles up the Columbia River.

Inspection of The Dalles Dam: 2:45 to 4:45 p.m.

Return: 6:30 p.m. to Hotel Multnomah by bus.

The Dalles Dam, a $225,000,000 project constructed by the Corps of Engineers, U. S. Army, is the newest of the large power and navigation dams on the lower Columbia River. Four of twenty-two 78,000-kw units are now operating. Others are in all stages of construction. A single 87.5-ft-lift lock and elaborate fish-passage facilities are features.

HAWAII POST-CONVENTION TOUR

Good fortune awaits those who decide now to join the group who fly to Hawaii after the Portland Convention. The Hawaii Section has technical sessions and tours which add to the attractiveness of this combination professional meeting and holiday opportunity. July 1 and 2 are the days of the sessions in Honolulu. Full details are carried in Civil Engineering for March, in pamphlets which have been circulated, or may be obtained from: Trade Wind Tours, 311 Lewers Road, Honolulu, Hawaii.

SOCIETY NEWS

Member Gifts Campaign Underway

The member gifts campaign, now underway all over the country, is for the construction of the new United Engineering Center, which will rise on United Nation's Plaza in New York. The campaign provides the opportunity for every member of ASCE interested in improving America's engineering leadership to do his part in assuring our Society's share of $800,000 toward the construction of the $10,000,000 Center.

Participation in an 8 percent share of the estimated cost seems modest enough for a once-in-a-lifetime member contribution toward an adequate working center for our profession. Particularly is this contribution a modest one, since many may find it convenient to make pledges payable at intervals over a three-year period. Gifts, of course, are deductible by donors in computing their net taxable income.

The Societies have long since outgrown their present headquarters, the Engineering Societies Building, which was the generous gift of Andrew Carnegie a half-century ago as a "home for engineers." The membership of the Societies has advanced at a faster rate even than the population of our country—from 16,000 in 1907 to 180,000 in 1957.

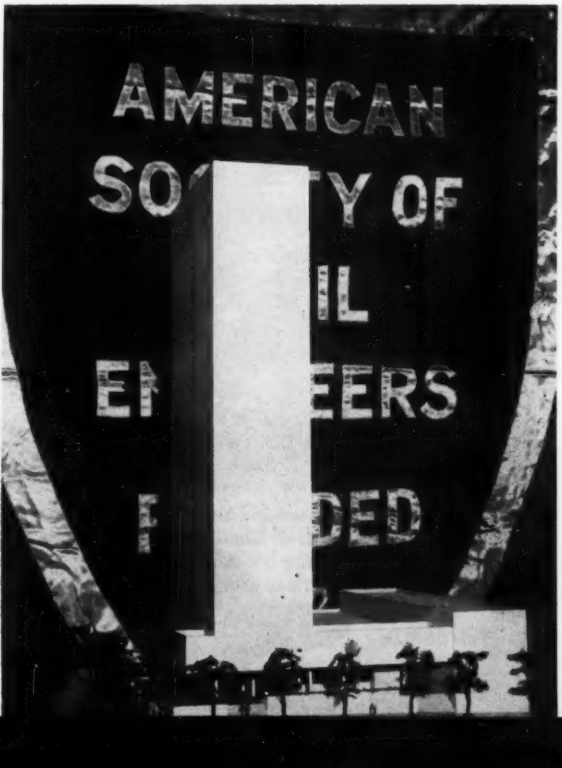
Along with membership growth, services to members have expanded many times. The volume of publications produced has tripled in the past 30 years. In this period the number of technical and professional committees has grown greatly; the number of meetings, including those of local sections, has quadrupled. The use of the Engineering Societies Library, both in person and by mail, telephone and telegraph, grows yearly. Not only is the interior design of the present building antiquated and wasteful of space, but there is no way in which additional accommodations can be provided for the associate societies that wish to occupy the same building.

United Engineering Trustees, on behalf of the Founder Societies, has established the fact that rehabilitation of the present Engineering Societies Building is not practical. It is no longer either adequate or economical. The conclusion is that a new United Engineering Center must be constructed.

Technological and scientific progress in the years to come will surpass that of every past era. Never before in history has the engineering profession been so essential to the shaping of world events. "We urgently need to start our new building," said Herbert Hoover. "It is of national importance. We need the support of all our members." Charles F. Kettering, honorary chairman of the Member Gift Campaign, adds, "I urge you to give, not only in dollars but in service to the campaign."

Engineering Societies Building, 1906-1960

United Engineering Center, 1960-?



Get Ready for the Portland Convention!

Portland, famed City of Roses, invites you and your family for a "Conventional" vacation and the ASCE Convention, June 23 to 27. The excellent technical and social program is detailed in this issue.

Oregon offers far more than meetings in June. It almost certainly will be beautiful weather, with warm days and cool nights. Scenery and points of engineering interest are unsurpassed in the Pacific Northwest. Within easy driving distance of Portland are scores of major dams, many currently under construction by public and private interests. Engineers will be welcome at all of these; just make arrangements with the constructing agency so there won't be a delay at the gate.

The Dalles Dam, on the Columbia River, several dams on the Willamette, and two on the Swift River, in varying construction stages, are within easy reach of Portland. New expressways, a bridge over the Columbia, and a greatly expanded water system have special interest for the engineer. Portland is a center of the lumbering industry.

And there is much more nearby: the 620-ft-high Multnomah Falls, Bonneville Dam, many snow-capped mountains, and the famed Oregon beaches. The blue waters of Crater Lake are alone well worth the trip to Oregon. There is also wonderful salmon fishing in the big rivers, with game fish in the mountain streams.

The annual Rose Festival is June 11-15, with the Grand Floral Parade of floats, bands and pageantry on the 14th. It can all add up to a wonderful time in the Northwest for your family if you make this a "Conventional" vacation with the Oregon Section.

Water and Wood Are Technical Program Topics

Papers on engineering aspects of water and wood, two topics of special interest in the Pacific Northwest, are featured in the Convention program. In accordance with Convention policy, however, the Portland program is a balanced one, covering all the facets of engineering interest. A great many of the papers will also have interest for the general public.

Water planning on a statewide basis and methods of increasing and conserving state supplies are among the highlighted topics in sessions of the Irrigation and Drainage Division. Other general subjects listed are underground reservoir replenishment and extraction, and drainage by surface drains and pumps. The Sanitary Engineering Division meetings will cover water-quality problems of the Columbia River, and pollution problems in the Willamette River Basin. Among the field trips planned are this Division's tours to Portland's watershed and headworks.

Control gates, reservoir outlets, and lock valves are among the topics for the Hydraulics Division sessions. This Division will hold a joint session with the Waterways and Harbors Division, at which the "General Plan for Columbia Basin Flood Control" and "Application of Snow Hydrology to the Columbia River Basin" will be the subjects of two papers. Four sessions of the Structural Division will feature wood, under the general discussion categories of design, building, bridges, and general. Topics will range from glued laminated construction in Europe to the use of timber in highway and railroad bridges. The Surveying and Mapping Division sessions will devote considerable attention to the problems involved in the relocation of railroads and highways required by the construction of dams.

A social highlight of the Convention will be a luncheon talk by Robert D. Holmes, governor of Oregon. Other prominent speakers are scheduled for other luncheon sessions.

H. Loren Thompson is general Convention chairman and Norbert Leupold is chairman of the Technical Program Committee.

Typical of Oregon's spectacular beaches is this stretch viewed from Neahkahnie Mountain, ten miles south of Cannon Beach. For those who want a view instead of swimming U. S. Highway 101 has been widened at various points to provide lookouts. Photo courtesy Oregon State Highway Department.

Hawaii Section Plans for Post-Convention Program

The group of engineers taking off from Portland the end of June for the Hawaii Section's Post-Convention Tour of the Islands and two-day technical meeting (July 1 and 2) will be headed by ASCE President Louis R. Howson and Samuel Morris, ASCE Vice-President for Zone IV. Both will be featured luncheon meeting speakers—Mr. Howson at a luncheon on July 1 and Mr. Morris at the July 2 luncheon. An address by William Quinn, governor of the Territory, will be an additional drawing card at the July 1 luncheon, while Mayor Neal Blaisdell of Honolulu will appear on the program with Mr. Morris.

Most of the technical sessions will be held in Honolulu's spectacular Dome Convention Hall, which will be the subject of one of the technical papers. Don L. Richter, design engineer of product development for Kaiser Aluminum & Chemical Sales, Inc., will outline past

developments in and future possibilities for the Kaiser aluminum dome. Another technical session will be devoted to a study of computers and their application in civil engineering. This will be presented by Reece S. Cave, Jr., time equipment division manager for the I.B.M. The overall Territorial highway program will be discussed in the opening talk, on July 1, by William Wachter, superintendent of public works for the Territory.

Of great interest in the Honolulu area will be the kick-off talk, on July 2, by Ralph B. Peck, research professor of soil mechanics at the University of Illinois. Dr. Peck will discuss the problems involved in constructing the soft-ground portion of Wilson Tunnel. Soil mechanics experts in the Territory will then present a panel discussion on the difficult soil problems to be solved in building the approach roads to the tunnel. Paul Liu will be the moderator. Simultaneously there will be a Hydraulics Panel, featuring representatives of the U. S. Geological Survey and similar agencies in the area.

Accommodations for mainland visitors are being reserved in the Hawaiian Village. Located on beautiful Waikiki Beach, the Hawaiian Village is a structure of considerable engineering interest as well as the newest and most complete convention hotel in the Territory.

Tours Offered at All Prices

As an example of the favorable tour rate in the Islands, Tour "A"—priced at $117.14 for one person sharing a double room—includes nine nights at the Hawaiian Village, all social activities, and sightseeing trips on the Island of Oahu. Ten- and eleven-day tours covering some of the other islands are also available. Trade Wind Tours of Hawaii is handling the tour for the Section.

Members Respond to Readership Survey

To make Civil Engineering more useful to its readers the editors have been conducting monthly surveys of reader opinion since 1949. These polls have sought answers to such questions as: Which feature do you like best? What is your favorite article? How can advertising be made more useful to you? What articles or features would you personally like to see in Civil Engineering?

Of the 2,400 members questioned last year (200 each month chosen at random), 714 went out of their way to tell what they liked and disliked in Civil Engineering and to make suggestions for future articles.

The average reader reported that he spent 3 hours and 23 minutes reading each issue. Feature articles were consistently rated as first choice, with "News Briefs" receiving a clear-cut vote for second place and "Do You Know That" winning the third-place honors. A tabulation of the articles voted best for the year is included below.

In answer to the question, "In your work do you direct the procurement of equipment and materials?" 66 percent replied in the affirmative. To the query, "Do the advertisers in Civil Engineering help keep you up-to-date on equipment and materials used in your work?" 76 percent said they did.

Month	Title	Author
Jan.	Adequate Highways for America	Rex M. Whitton
Feb.	Concrete Bridge Across Lake Pontchartrain Completed in Record Time	Myers Van Buren
March	The Civil Engineer Through the Ages: Egypt, Part 2	J. K. Finch
April	Precast Concrete Shows 21-Percent Saving on Air-Base Buildings	Marvin E. Warner
May	Dallas Memorial Auditorium: Cantilevers Support Dome of 204-Ft diameter	Allan D. Anderson Boyd G. Anderson
June	Prestressed Concrete—Difficulties Overcome in Florida Bridge Practice	W. E. Dean
July	Needed—Engineers in Public Office	George D. Clyde
Aug.	Unconventional Four-Level Interchange—New Orleans	Shu-T'ien Li
Sept.	The Engineer Through the Ages: Roman Republic, Part 2	J. K. Finch
Oct.	Mexico City's Earthquake Damage Examined	J. H. Thornley Pedro Albin, Jr.
Nov.	*Lessons from Cold-Weather Concrete Failures *The Engineer Through the Ages: Roman Empire, Part 2	H. J. Racey J. K. Finch
Dec.	$49,000,000 Project for Southern Pacific Crossing of Great Salt Lake	W. M. Jaekle

** Tied for first place in November*

New England Council Has Fifth Annual Conference

Some 280 engineers and their families enjoyed the Fifth Annual Conference of the New England Council, held at the University of New Hampshire on March 29. The Maine Section's New Hampshire Branch was host to the group, which included ASCE Honorary Member Ole Singstad, one of the featured speakers; Waldo G. Bowman, ASCE Vice-President for Zone I; Weston S. Evans, Society Director for District 2; and ASCE Executive Secretary William H. Wisely. William P. Kimball was chairman of the successful all-day program.

In one of the leading talks Brig. Gen. Alden M. Sibley, division engineer for the New England Division of the Corps of Engineers, described the Passamaquoddy Tidal Power Survey. With the possibility of exhausting our fossil fuels imminent, General Sibley warned that we must look to other sources of energy. Sixty plans for harnessing the powerful 50-ft-high tides in the Bay of Fundy have been analyzed, and the Passamaquoddy Survey is now concentrating on a two-pool system as most feasible. The extensive mathematical calculations involved in making the survey are being helped along with the aid of electronic digital computers. Sonic explorations, supplemented by spot core drilling, are being made to determine what materials should be used in constructing dams and barriers in locations where the water is from 300 to 400 ft deep and the overburden is up to 200 ft deep. General Sibley showed that power consumption is directly tied to our standard of living.

Mr. Singstad's paper, given with the aid of slides, compared the shield and open-trench methods of tunnel construction, with reference to the Queens-Midtown, Holland, Brooklyn-Battery, and Baltimore Harbor tunnels. Mr. Singstad showed that, under the proper circumstances, the trench method of construction is the most economical.

Society officials were the luncheon meeting speakers. In his talk, which dealt with professional unity, Mr. Wisely expressed the encouraging opinion that "the engineering profession is much closer to unity than is realized."

The afternoon was devoted to the "Dew Line," America's recently constructed 3,000-mile defense line of radar stations extending from northern Alaska to the east coast of Baffin Island. The speakers were Eugene A. Carlson and Harold F. Flanders, of the Western Electric Company (prime contractors on the project), and Prof. Carl F. Long, of the Thayer Engineering School. Prof. Richard Hill, of the University of Maine, was principal speaker at the dinner that evening.

More "Seven Wonders" Plaques Presented

Plaque honoring the San Francisco Bay Bridge as one of the Seven Civil Engineering Wonders is presented by ASCE President Louis R. Howson (right) to C. M. Gilliss, director of public works for the state. The bridge was cited as a "Unique Over-Water Steel Structure." Presentation of the plaque took place at a special ceremony at the bridge site on March 17.

On behalf of ASCE, President Louis R. Howson presents plaque honoring Grand Coulee Dam and the Columbia Basin Project as one of the Seven Civil Engineering Wonders of the United States. Seen here, in usual order, are A. J. Davidson, head of the Design Branch of the Bureau of Reclamation, Columbia Basin Project; P. R. Nalder, project manager for the Columbia Basin Project, who accepted the plaque for the Bureau of Reclamation; President Howson; ASCE Director Louis Rydell; and Edwin Nasburg, chief of the Hydrography and Drainage Branch of the Columbia Basin Project and president of the Spokane Section. The bronze plaque is mounted on a concrete monument, overlooking the spillway of the dam, where it will be seen by thousands of visitors each year. The project—selected two years ago by a board of judges of the Society—was cited as "an Engineering Marvel."

Chicago Nuclear Congress Draws Civil Engineers

Both the program presented at the Chicago Nuclear Congress and attendance records were indicative of the growing concern of civil engineers for the part they must play in the rapidly developing atomic power industry. This 1958 Nuclear Congress was actually a joint assembly of four related activities: the Fourth Nuclear Engineering and Science Conference, the Atomic Energy Management Conference, the Sixth Hot Laboratories and Equipment Conference, and the Atom Fair. ASCE was a sponsor and participant in the Nuclear Engineering and Science Conference.

The sessions which attracted most attention on the part of civil engineers were those devoted to reactor location and safety, reactor shielding and containment, water contamination and treatment, and waste treatment and disposal. All these involved civil engineering disciplines, and presented papers arranged through the efforts of the ASCE program representative, James G. Terrill, Jr.

Site Location Studied

The topographic, geologic, hydrologic, industrial, agricultural and population density factors were studied in detail during presentation of a paper on physical factors affecting location of a nuclear reactor in Florida, and the discussions that followed. New and more intensive appraisal of the land-use factors involved was urged, presenting a new challenge to city planners.

One whole session was devoted to reactor shielding and containment, under the chairmanship of Harry L. Bowman, representing ASCE. The new factors affecting design of structures and facilities were discussed, including the measured effects of heat and radiation. Spectacular structures are involved in the design and erection of reactor shells. These large shells, employed for the containment of lethal substances, have to have built-in safety factors new to structural designers. They pose very interesting problems.

Engineers of several disciplines, as well as chemists and physicists, are involved in the studies made necessary by nuclear contamination of water. There were extensive sessions and discussions, presenting the new knowledge afforded by recent studies in this field. Not only nuclear plant water, but water supply for municipalities and entire watersheds is involved. Very complicated test procedures were discussed in some detail during these sessions.

Nuclear Congress objectives received the acclaim of Vice President Richard Nixon. With the Vice President on the dais are Chicago's mayor, Richard Daley; Congress Chairman Bruce Prentice; and Toastmaster John R. Dunning, dean of engineering at Columbia.

A major address of the conference was presented by Vice President Richard Nixon, who took this occasion for a major policy address. Mr. Nixon discussed in some detail the situations produced by atomic tests. He expressed the opinion that the mere stopping of atomic tests is not going to reduce the danger of war. He said the only formula that goes to the heart of the problem is the proposal of the United States for control of production as well as tests of nuclear weapons. Vice President Nixon was introduced to the engineers and scientists gathered for the conference by Lewis L. Strauss, chairman of the Atomic Energy Commission, who had accompanied the Vice President to Chicago for this meeting.

Although some 30 organizations participated in the Congress, the effort was coordinated by Engineers Joint Council. Inquiries regarding papers, and orders should be sent to the American Institute of Chemical Engineers, 25 West 45th Street, New York 36, N. Y.

ASCE Membership as of April 9, 1958

Members	9,909
Associate Members	13,511
Junior Members	17,222
Affiliates	77
Honorary Members	44
Total	40,763
(April 9, 1957	39,520)

ASCE Education Policy Emphasizes Graduate Study

In a recent statement of policy ASCE urged that any additional Federal funds which may be provided for education should be used for the encouragement of graduate study and the improvement of teaching at both the collegiate and secondary levels. Thus, by implication, the Society showed its unwillingness to subscribe to an Administration proposal for a huge outlay of Federal funds for the establishment of undergraduate scholarships to encourage students in science and engineering pursuits.

The Society action followed a report of the results of a survey of San Diego County (California) high school students, which showed overwhelming agreement that lack of scholarships does not keep students from choosing science and engineering as careers.

The statement urged that any additional funds provided for the physical, mathematical, biological, and engineering sciences should continue to be administered by the National Science Foundation. It also recommended that existing educational agencies be utilized in any expanded Federal participation in education, and opposed the creation of any new organizations.

The policy statement was drafted by the Society's Committee on Engineering Education and approved by the Executive Committee of the Board of Direction, with the recommendation that it be transmitted to the Senate Committee on Labor and Public Welfare, the House Committee on Education and Labor, and other interested groups in government.

The specific recommendations of the Policy Statement follow:

"1. It is essential, in any legislation which may provide for increased Federal participation in education at any level, to guarantee that the autonomy of local agencies and individual institutions to determine educational policy, philosophy, and procedure be retained.

"2. Any expanded Federal participation in education should be accomplished by the utilization of existing agencies rather than by the creation of new organizations.

"3. Any additional Federal funds which may be provided for education should be used for the encouragement of graduate study and for the improvement of teaching at both the collegiate and secondary levels, and that funds provided for the physical, mathematical, biological and engineering sciences should continue to be administered by the National Science Foundation.

"4. Such legislation should increase the funds available to the National Science Foundation for the support of the physical, mathematical, biological, and engineering sciences through research and graduate education.

"5. Grants for graduate study should be available both to full-time students and to teaching fellows engaged in part-time study.

"6. The proportion of National Science Foundation funds allocated to engineering sciences should be established on the basis of a realistic and unbiased analysis of need and the national interest."

Bar Association Opposes Competitive Bidding

According to an opinion of the Professional Ethics Committee of the American Bar Association (Opinion 292, adopted October 15, and published in the December 1957 issue of the ABA Journal), the "engagement of attorneys by a public agency or any other person seeking their services, as well as the amount of their fee for legal work, are not proper subjects for competitive bidding."

The opinion arose out of a request of a city bar association for a ruling concerning the following situation: Representatives of the School Board of a city contacted several attorneys and firms of attorneys in the community requesting a firm figure for handling the School Board's legal work in connection with acquisition of property, and straightening out titles to property already owned, all related to a large school construction program.

The local attorneys expressed their belief that the School Board's procedure would result in competitive bidding, and therefore would not be in the public interest. Such a procedure would not take into account the normal personal relationship between client and attorney, nor consider the true worth of the services rendered and the intangible factors important in the employment of an attorney.

In its opinion, ABA's Professional Ethics Committee remarked that the legal profession is essentially a branch of the administration of justice; that it is "not a mere money making trade"; and that competitive bidding has been specifically condemned. It ruled that competitive bidding of this nature for legal work, even though requested by a client, would be considered in violation of the Canons of Professional Ethics of the Association.

Division Doings

Executive Committee Chairmen of Technical Divisions

CARL M. BERRY
Surveying and Mapping Division

ELDON V. HUNT
Pipeline Division

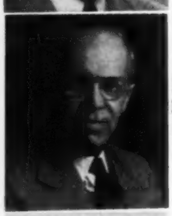
J. CAL CALLAHAN
City Planning Division

R. R. KENNEDY
Sanitary Engineering Division

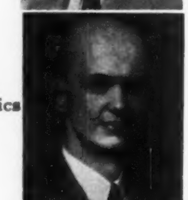
LEO H. CORNING
Structural Division

HAROLD M. MARTIN
Hydraulics Division

H. T. CRITCHLOW
Irrigation and Drainage Division



JOHN S. MCNOWN
Engineering Mechanics Division



RALPH E. FADUM
Soil Mechanics and Foundations Division

W. A. MCWILLIAMS
Highway Division

ROGER H. GILMAN
Waterways and Harbors Division

WARREN N. RIKER
Construction Division

ROBERT HORONJEFF
Air Transport Division

G. R. STRANDBERG
Power Division

Structural Division Conference On Electronic Computation

The Structural Division is planning a two-day conference devoted to structural applications of electronic computers, to be held in Kansas City, Mo., November 20 and 21. Sponsors will be the Division's Committee on Electronic Computation and the Kansas City Section.

To assure a broad and interesting range of papers, the Committee on Electronic Computation is inviting all interested and qualified persons to contribute papers. *Those interested in attending or presenting papers are requested to fill out and mail the coupon on page 149 of the advertising section as an aid to the organizing committee.*

A program of four half-day sessions is planned, each session to have a central topic covered by three or four 20- to 30-minute papers plus discussion. It is planned to make the sessions helpful to engineers just getting started in the field as well as to advanced users of electronic computers. Suggested possibilities for topics include the following:

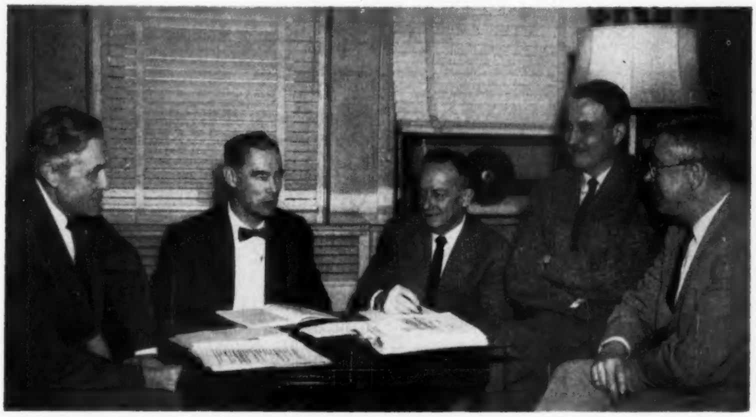
1. Orientation and philosophical background.
2. Numerical methods in electronic computation.
3. Programming and coding techniques.
4. Computer-group organization and machine selection.
5. Design problems: reinforced concrete, prestressed concrete, steel.
6. Steel fabrication and erection problems.
7. New applications and future potentialities.

The ideal paper is described as one that is prepared first with publication in mind (in accordance with Structural Division basic manuscript requirements) and then abstracted to suit the time limitations and other requirements of an oral presentation. However, top-quality papers prepared primarily for oral presentation will also be welcome.

Prospective speakers are asked to submit abstracts of their papers to Jackson L. Durkee, Chairman of the Task Committee on Publications and Technical Sessions, before June 15. Complete manuscripts must be received before August 15, and final selections will be announced by September 15. Mr. Durkee may be addressed in care of the Bethlehem Steel Company, Bethlehem, Pa.

General inquiries concerning the conference or the Committee on Electronic Computation should be addressed to the secretary of the committee, Steven J. Fenves, Room 420, Civil Engineering Hall, University of Illinois, Urbana, Ill.

Executive Committee of Surveying and Mapping Division



Ways and means of increasing the effectiveness of the Surveying and Mapping Division was the subject of a recent all-day meeting of the Division's Executive Committee held at the Shoreham Hotel in Washington. In session here, in usual order, are Earle J. Fennell; Carl M. Berry, committee chairman; Franklin R. Gossett; Milton O. Schmidt, vice-chairman; and Oscar C. J. Marshall. The next meeting of the Executive Committee is planned for New York City in October during the Annual Convention.

Canada and U. S. to Be Host to International Meetings

A series of international meetings of prime importance to engineers will be held in Canada and the United States this coming September. The meetings and tours have been carefully scheduled to permit attendance at all events without conflict. The unique "package" of meetings will attract engineers and scientists from all over the world. Seldom, if ever again, will there be such a chance for United States engineers to see and hear so much without the expense and red tape of travel abroad.

The Committee on International Relations of Engineers Joint Council announces the following schedule of meetings and dates:

September 3-6—Fifth Convention of the Pan American Federation of Engineering Societies (UPADI), Montreal, Canada.

September 7-11—Sectional Meeting of the World Power Conference, Montreal.

September 11-14—Study of the St. Lawrence River Navigation and Power Projects, Niagara Falls, and the Shippingport (Pa.) Nuclear Power Station.

September 15-20—Sixth International Congress on Large Dams, Hotel Statler, New York City.

A choice of three Study Tours to different parts of the United States will be available at the close of the Sixth International Congress on Large Dams. All three Tours will take a complete week. Travel will be by train, airplane or specially chartered motor coaches, as the distance from New York indicates. Stopover visits to additional dams in the area may be arranged at the time of making reservations for the Study Tours.

Tour No. 1 specializes in the Southeastern Region of the United States, with special attention to the projects of the Tennessee Valley Authority, the Aluminum Company of America, and the Alabama Power Company. The Waterways Experiment Station at Vicksburg, Miss., will also be visited.

Tour No. 2 specializes in the Midwestern Region and will include visits to the Missouri Valley dams in the Great Plains region and to the Bureau of Reclamation in Denver.

Tour No. 3 specializes in the Northwestern Region and will visit a number of Columbia River dams under construction.

Application for taking one of the Study Tours must be made with Thomas Cook & Son or Wagons-Lits/Cook before June 1. Application blanks, costs, and other details are available from the U. S. Committee on Large Dams, which may be reached through Engineers Joint Council, 29 West 39th Street, New York 18, N. Y.

E. S. Library Issues New Bibliography

Availability of another reference in its continuing series of bibliographies is announced by the Engineering Societies Library. The new listing, identified as "E. S. Bibliography No. 12," contains over 150 annotated references to books and magazine articles on adhesive metal-to-metal bonding published in the past ten years. It covers all aspects of the subject, including references to theory, technology, properties, and methods of application.

Bibliography No. 12 may be purchased from the Engineering Societies Library, 29 West 39 Street, New York 18, N. Y. The price is $2.00.

Trophy for C.E.'s West Coast Advertiser

In a recent confidential poll of all Pacific Coast advertising agency space buyers to determine the publishers' representative performing the greatest service to its publishers and agencies on the West Coast, McDonald-Thompson—Civil Engineering's West Coast advertising agency—placed first and has been awarded the 1957 Space Buyers Grand Trophy. Presentation of the trophy to McDonald-Thompson was made by James Speer, president of the Western States Advertising Agencies Association.

ASCE QUARTERLY ENGINEERING SALARY INDEX

Consulting Firms

City	Current	Last Quarter
Atlanta	1.11	1.11
Baltimore	1.11	1.11
Boston	1.13	1.13
Chicago	1.30	1.26
Denver	1.19	1.19
Houston	1.12	1.08
Kansas City	1.14	1.14
Los Angeles	1.16	1.16
New York	1.20	1.17
Pittsburgh	0.93	0.93
Portland (Ore.)	1.15	1.15
San Francisco	1.17	1.18
Seattle	1.06	1.07

Highway Departments

Region	Current	Last Quarter
I, New England	0.85	0.88
II, Mid. Atlantic	1.17	1.15
III, Mid. West	1.15	1.24
IV, South	1.07	1.02
V, West	0.97	0.96
VI, Far West	1.15	1.15

Figures are based on salaries in effect as of Nov. 15, 1957. Base figure, the sum of Federal Civil Service, G. S. Grades 5, 7, and 9 for 1956, is $15,930.

New Demand for Engineers Foreseen for 1958

At the end of 1957 the technological manpower supply came closer to meeting the demand than it has at any time since June 1950. However 1958 will probably see any existing surplus in supply wiped out. This is the opinion of the Engineering Manpower Commission of Engineers Joint Council, which finds a startling analogy between 1950 and now.

In June 1957, EMC points out, engineering graduates numbered 31,211, in contrast with the 19,600 available three years earlier. In June 1950 there was available a peak supply of 50,000 graduates, which represented a steady growth from the wartime low point. EMC sees the same factors contributing to the improved supply in both 1957 and 1950—dislocations caused by military cutbacks, Air Force switchovers, Congressional economies, and a pause in the economic upswing.

In a preview of what may be expected in 1958, EMC states, "That small but stubborn coterie which, for seven years, has seen a surplus in virtually every unemployed engineer was sure it had found one in the situation that developed during the summer of 1957. Ignored was the fact that it took seven years of unremitting effort, plus an economic pause, to narrow the gap between supply and demand. The fact is, the near balance that currently exists is as precarious as it was in the spring of 1950. With the appearance of Sputnik on the horizon its existence was immediately threatened, and in 1958 it will unquestionably disappear."

For 1958, EMC foresees "a spate of bills designed to recruit more students of science and engineering." The Manpower Commissions are already being consulted, it says, "and are attempting to shift Congressional attention to the more urgent problems of basic pre-college training, of facilities for training students at the college level, and of teacher supply at all levels." New government stress upon research and development is expected to drain the supply of highly trained engineers and scientists currently engaged in university teaching.

The Engineering Manpower Commission is one of the most valuable activities of Engineers Joint Council. Organized in 1950, it has been instrumental in promoting interest in careers in engineering and science and in proper utilization of engineering manpower. Financed by contributions from industry, it has worked closely with the Scientific Manpower Commission. The two commissions cooperate in publishing a monthly newsletter, which now has a circulation of 12,000.

The Engineering Manpower Commission of EJC has its headquarters at 29 West 39th Street, New York 18, N. Y. W. T. Cavanaugh is executive secretary.

ASCE CONVENTIONS

PORTLAND CONVENTION
Portland, Ore.
Multnomah Hotel
June 23-27, 1958

ANNUAL CONVENTION
New York, N. Y.
Hotel Statler
October 13-17, 1958

LOS ANGELES CONVENTION
Los Angeles, Calif.
Hotel Statler
February 9-13, 1959

TECHNICAL DIVISION MEETINGS

THIRD NATIONAL CONGRESS ON APPLIED MECHANICS
Providence, R. I.
Brown University
June 11-14

Sponsored by
ASCE Engineering Mechanics Division
Brown University

HYDRAULICS CONFERENCE
Atlanta, Ga.
Georgia Institute of Technology
August 20-22
Sponsored by
ASCE Hydraulics Division
ASCE Georgia Section
Georgia Institute of Technology

IRRIGATION AND DRAINAGE CONFERENCE
Memphis, Tenn.
September 25-27
Sponsored by
ASCE Irrigation and Drainage Division

LOCAL SECTION MEETINGS

Colorado—Host to Student Chapters at the University of Denver, Colorado State University, and the University of Colorado, May 12.

Illinois—Weekly luncheon meetings at the Chicago Engineer's Club every Friday at 12 noon.

Metropolitan—Regular meeting in the Engineering Societies Building, May 21 at 7 p.m.

Los Angeles—Dinner meeting in the Rodger Young Auditorium, May 14, at 6:30 p.m.; meeting of the Soil Mechanics Group in the Rodger Young Auditorium, May 21, at 6:30 p.m.; meeting of the Construction Group, Michael's Restaurant, May 22, at 6:30 p.m.; meeting of the Transportation Group, Engineers' Club, May 27, at 6:30 p.m.; and meeting of the Sanitary Engineering Group, Engineers' Club, May 28, at 6:30 p.m.

Philadelphia—Annual meeting and installation of officers at the Engineers' Club on May 13. Central Pennsylvania Branch's dinner meeting at Van's Restaurant in Harrisburg, May 14, at 6 p.m.

Sacramento—Weekly luncheon meetings at the Elks' Temple every Tuesday at 12 noon.

Tennessee Valley—Spring meeting in Kingsport, Tenn., May 23-24. Chattanooga Branch dinner meeting at Hotel Patton, May 13, at 5 p.m.

Virginia—Norfolk Branch meeting the third Monday of every month at 12 noon in the YWCA Cafeteria; Richmond Branch meeting the first Monday of every month at 12:15 p.m. in the Hot Shoppe Cafeteria; Roanoke Branch meeting the second Wednesday of every month at 6:30 p.m. in the S & W Cafeteria.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

The **Central Illinois Section's** March meeting featured Howard F. Peckworth, ASCE Director for District 8, as speaker. In a talk on unity of the Society, Mr. Peckworth traced ASCE's history and many of its modern functions. He also discussed the unification of the profession.

"Electronic Computers and the Civil Engineer" was the engrossing topic for the **Cincinnati Section's** March meeting. J. C. Richter, of the General Electric Company, related some of the details of computer work being handled by his company and gave a glimpse of things to come in the computer field. Erwin Bretscher took the historical view of computers and outlined past, present, and future developments. Carl Vogt rounded out the discussion with some theories on the possible effect of electronic computers on civil engineering work. A question-and-answer period followed.

The **Florida Section** has a new Branch following Board of Direction approval of the formation of an **East Coast Branch** for members in the Orlando area. The members of the new Branch have chosen the following officers to get their activities going: William A. Bellisle, president; Homer B. Wright, vice-president; and Wayne D. Heasley, secretary-treasurer.

The Atlanta Airport, fifth largest in the nation, was the subject of a recent **Georgia Section** program. In the featured talk Edward A. Moulthrop, of Roberts and Company Associates, Atlanta, discussed a $14,000,000 program of additions and improvements planned for the airport. The terminal's current facilities permit parking 35 planes simultaneously, more than at any other airport of its size.

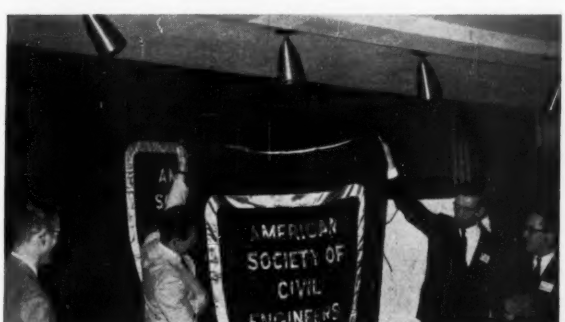
The **Intermountain Section** held three meetings during February, all to discuss the possible formation of new Branches. In Provo, Salt Lake City, and the Logan-Brigham area, members approved the idea of new Branches, and at all the meetings further investigation of the subject was ordered. Interesting talks highlighted all three programs. In Provo, Glenn L. Enke presented a paper on "The Professional Problems of the Engineer." A panel discussion on Utah's highway problem was conducted by Ellis Armstrong, director of the Utah State Road Commission at Salt Lake City. And the Logan-Brigham meeting heard Frank W. Dalton speak on solid fuels for rocket engines.

Presentation of the **Iowa Section** annual prizes to Student Chapter members took place at the Section's February meeting in Des Moines. The winners were Richard Marr, of Iowa State College, and Roger Stoughton of Iowa University. The Highway and Municipal Sections of the Iowa Engineering Society joined the members to hear Ned Ashton, Iowa City consultant, speak on "Iowa's Welded Aluminum Bridge."

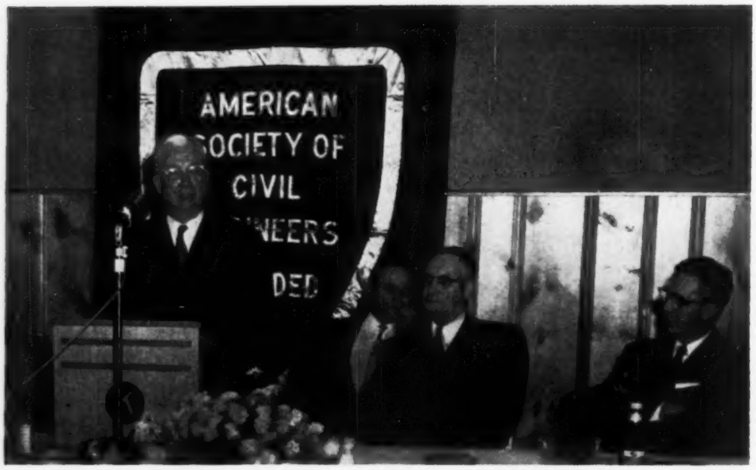
Members of the **Kansas Section** discussed the proposed Surveyors License Law at their March meeting. R. S. Delameter spoke to the point, saying that separation of surveying and civil engineering would create a number of hardships on engineers. One of the problems would be that students would not be able to study surveying in a civil engineering course, B. L. Smith pointed out. In the featured talk Dr. William E. Mowery spoke on engineering contributions in the field of surgical instruments and appliances.

The **Lehigh Valley Section** joined the American Welding Society in a joint dinner meeting in Allentown in March. The first speaker was Society Director E. L. Durkee, who gave an illustrated talk on repairing the Easton (Pa.) Bridge, a cantilever-type structure damaged in the 1955 flood. Omer W. Blodgett, design consultant with the Lincoln Electric Company, spoke on "Welded Girders," pointing out the advantages of welded construction over riveted in cost and saving of weight.

Members of the **Maine Section's Vermont Branch** recently were guests of the Western Foundation Co. and the Gilbane Construction Co. at the construction site of the new National Life Insurance Co. Building in Montpelier. After the inspection, members met to hear F. L. Jenkins, vice-president of the Western Foundation Company, speak on design and construction details of caisson footings in solid rock. A film on the subject was shown.



Fairbanks Branch of Alaska Section presents student banner to Student Chapter at University of Alaska. At presentation are (left to right): Winfield G. Beach, vice president, Student Chapter; Joseph A. Baldwin, secretary, Student Chapter; Conrad G. B. Frank, president, Fairbanks Branch; and William W. Mendenhall, secretary-treasurer, Fairbanks Branch. Speaker at meeting was Robert W. Retherford, consulting engineer of Anchorage, who spoke on "Mine Mouth Power Plant at Healy."



Honored guests and Section members at the head table at the Mid-Missouri Section's March meeting are (left to right): President Louis R. Howson; Leon Hershkowitz, Section president; E. W. Carleton, chairman of the department of civil engineering at the university; and Rex Whitton, chief engineer, Missouri State Highway Commission. At table, but not in photo, were Adrian Pauw, professor of structural engineering, University of Missouri, and William Hedley, ASCE Director for District 14.

In preliminary competition for the D. V. Terrell Award are three Kentucky Section Junior Members. Shown here (left to right) are: Dean Terrell, Past-President in whose honor the award was established; Sammie Lee, whose paper will represent the Section in competition; contestants Samuel Maggard and Glenn Alderdice; and J. C. Cobb, prominent Section member.

The technical session of the **Maryland Section's** March meeting was in the hands of Student Chapters at the University of Maryland and Johns Hopkins University. Donald Hughes, of the University of Maryland, presented a paper on developments in the field of air-entrained concrete. John C. Schaake, Jr., of Johns Hopkins, followed with a paper on "Power from the Sea," which stressed the great potential of this source of power.

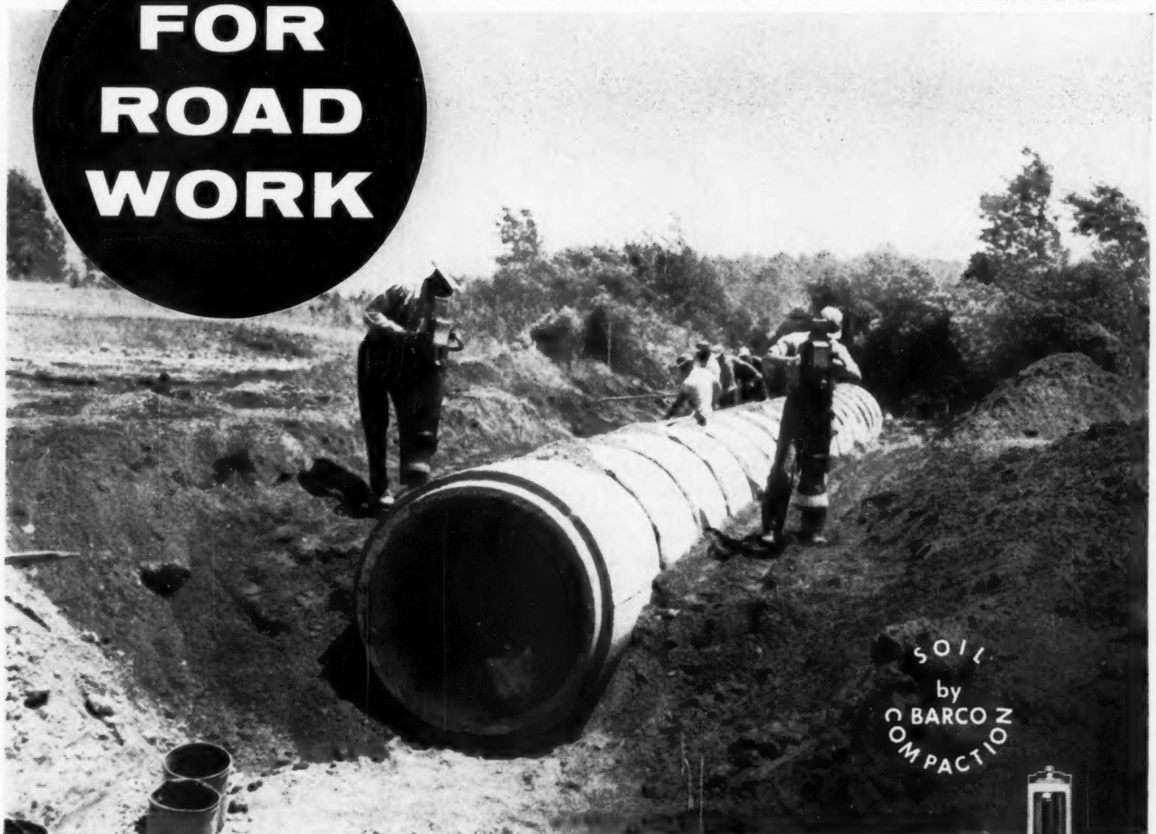
Newly elected **Metropolitan Section** officers are: Richard H. Tatlow III, president; Robert H. Dodds, vice-president; Brother B. Austin Barry, secretary; and Stanley M. Dore, Arthur J. Fox, Jr., and Irvine P. Gould, directors. The new slate will take office on May 21. On April 12, the **Junior Member Forum** sponsored a lively panel discussion on suburban commutation in the New York City area. The panel of experts consisted of: W. R. McConochie, chief of traffic transportation section, De Leuw, Cather and Company; J. S. Gallagher, director of passenger research, New York Central Railroad; Stanley Tankel, senior planner, Regional Plan Association, Inc.; and H. A. Potterton, transportation manager, Public Service Coordinated Transport. F. W. Herring, chief of the Planning Bureau of the Port of New York Authority, was the moderator.

At the March meeting of the **National Capital Section** William C. Graeub read the paper which he is entering in the Daniel W. Mead Junior Member Prize Competition. Dr. A. Allen Bates, vice-president for Research and Development with the Portland Cement Association, spoke on engineering research. His talk ranged from the philosophy of research to the practical problems facing research organizations.

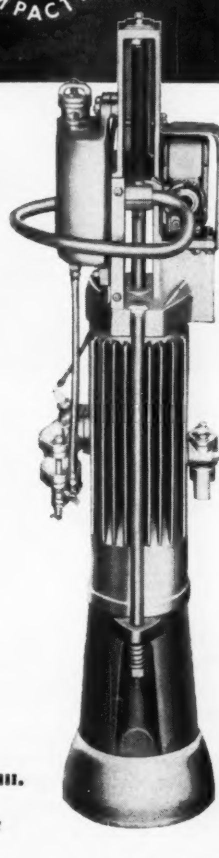
The **Oregon Section** met in February to hear Thomas McClellan, associate professor of civil engineering, Oregon State College, present plans for revising the Oregon State College civil engineering curriculum. The new schedule is based on emphasis on the fundamental sciences and is consistent with the report of the ASCE Task Committee on Engineering Education. The civil engineering department at the college will make the suggested changes in the curriculum starting in September of 1958. Ben Pugh, a senior in civil engineering at the college, presented an illustrated talk on the senior field trip which included a tour of engineering works from Murph's Beach to San Francisco.

There will be rejoicing on the literary scene at the reappearance of the **Philadelphia Section's** publication, "The News." Publication of the 30-year old newsletter has been suspended for the past year in favor of participation in "The Delaware Valley Engineer." Now the Section will have an outlet in both publications. At a recent Section meeting, Life Membership Certificates were given to Ernest W. Baldwin, Harry L. Bowman, Arthur A. Noel Feniglio, Alexander Maltman, Horace B. Nicholson, Joseph A. Russell, and Clarence P. Schantz. At the March meeting, members heard D. L. Richter, research engineer with Kaiser Aluminum Products Development Company, discuss two

Tamping fill around 4 ft. concrete pipe culvert on New York State Thruway Extension near West Seneca, N. Y. The Barco Rammers are owned by S. J. Groves & Sons Co., Syracuse, N. Y. (Photo: CONSTRUCTIONEER)



Barco Rammers are Essential!



CHECK THE RECORDS for *soil compaction* on every top ranking highway, toll road, thruway, or freeway built in recent years and you will find Barco Rammers! Here are the reasons:

The key to better construction—

No modern trend in construction has had a more phenomenal growth than the specification of HIGH DEGREE SOIL COMPACTION for all kinds of projects for longer life and better value.

Easily meet rigid specifications—

In test after test, Barco Rammers have demonstrated their ability to deliver 95% to 97.5% compaction (modified Proctor Method)—EASILY! EFFICIENTLY! ECONOMICALLY! The Barco Rammer is especially useful for compacting fill in restricted areas. ONLY the Barco Rammer can produce specified high degree compaction on lifts up to 20 inches.

Get jobs finished on time—

One of the biggest advantages offered by Barco Rammers is ability to handle work in minimum time. On area tamping, one man can average 20 to 30 cubic yards of fill per hour. On trench backfill, using lifts up to 24", the rate for 18" trench is 360 to 600 feet per hour. Ask for a demonstration.

PRODUCTS BACKED BY EXPERIENCE
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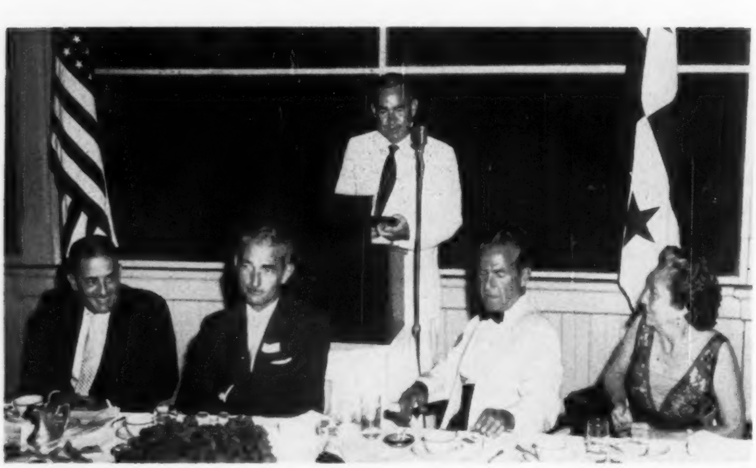
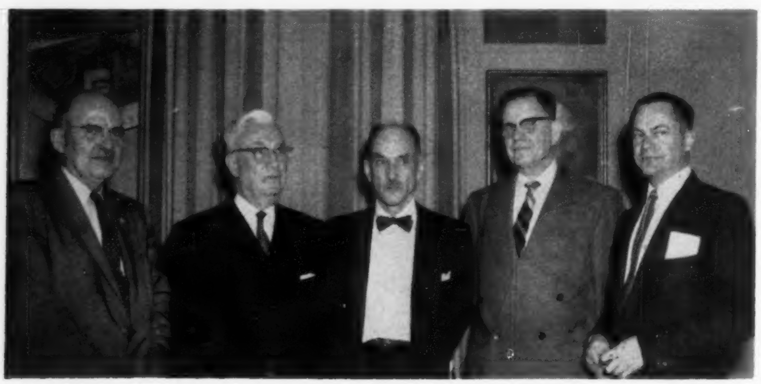
BARCO MANUFACTURING CO. 561F Hough St., Barrington, Ill.

BARCO RAMMER
for High Degree Soil Compaction

BARCO VIBRA-TAMP
for Granular Fill and Bituminous Surfacing



Col. Hugh M. Arnold, Lt. Governor of the Canal Zone and member of the Panama Section, acknowledges award as Engineer of the Year at Engineers' Week Dinner Dance. This function culminated Engineers' Week in Panama and the Canal Zone and featured an address by the President of the Republic of Panama, His Excellency Ernesto de la Guardia, Jr. The Panama Section was one of the sponsoring groups. Shown (left to right) are: L. B. Sartain, president of the Canal Zone Society of Professional Engineers; President de la Guardia; Colonel Arnold (standing); Maj. Gen. William E. Potter, governor of the Canal Zone and Section member who introduced the President of the Republic; and Mrs. Mercedes Galindo de la Guardia.



Members of the Seattle Section heard President Louis R. Howson speak on Society affairs and the new United Engineering Center at their February meeting. Here, in usual order, are Prof. Fred Rhodes, Mr. Howson, Prof. Frederick B. Farquaharson, Louis E. Rydell, ASCE Director for District 12; and Thomas Campbell, Section president.

relatively new experiments in structural methods. The first is structural aluminum fabrication and the other, the aluminum dome. It was forecast that the future may see aluminum framing of structures and aluminum dome roofs competing with other structural systems. The meeting was arranged by the Junior Member Forum.

At the **San Francisco Section's** February meeting the 1957 Daniel W. Mead Student Prize was presented to Robert D. Frowein. Program speaker was Francis N. Hveem, materials and research engineer of the California Division of Highways, with a talk on the AASHO highway test track. Mr. Hveem presented the objectives of the project and an analysis of the problems being encountered on this $23 million research project.

Col. Charles B. Schweizer, district engineer of the St. Louis District of the Corps of Engineers, was guest speaker at the **St. Louis Section's** February meeting. His topic was "Reconstruction of the Hwachon Dam." He preceded his formal speech with an enlightening discussion of the St. Louis Flood Control Program.

New **Seattle Section** officers were recently installed. They are: Thomas Campbell, president; John Hoving, vice-president; Leland Spahr, secretary; and Robert Johnson, treasurer. Two members, Wayne Lincoln and A. L. Miller, received Life Membership Certificates at the meeting.

Columbia, S. C. was the scene of the **South Carolina Section's** recent joint meeting with the South Carolina Society of Engineers. This annual winter meeting consisted of two technical sessions, plus a number of strictly social affairs. Speakers at the technical sessions were Dr. Ralph Swann, assistant director for research and rockets at the Redstone Arsenal, Huntsville, Ala.; C. R. McMillan, chief highway commissioner of South Carolina; and F. E. Edlin, consultant to the Engineering Service Division of Du Pont in Wilmington, Del.

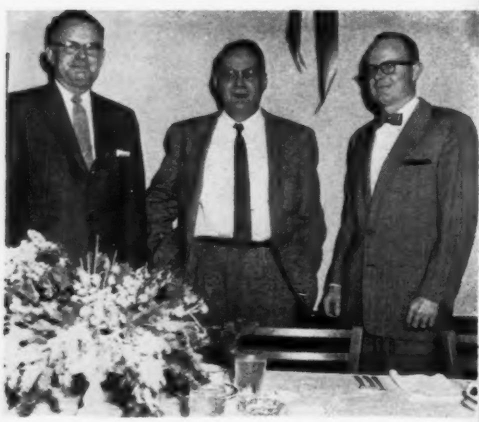
At a special luncheon meeting for President Louis R. Howson, the **Tacoma Section** heard Mr. Howson speak on the Society's organization and explain its part in the construction of the new United Engineering Center in New York City. Mr. Howson's visit to the Section was in connection with the presentation of one of the "Seven Wonders of Engineering" plaques to Grand Coulee Dam.

At a recent meeting of the **Toledo Section**, the members met with the Toledo Chapter of the American Institute of Architects. A group of guest speakers discussed the many various facets of successful planning and construction of penal and corrective institutions. The panel of experts consisted of Orville Bauer, architect, E. A. Picardi, structural engineer, Robert Moorhead, mechanical engineer and John Richards, partner with Bellman, Gillette and Richards. All these men are with the same firm. The panel was headed by Chief Koeblentz of the Division of Correction, Department of Mental Hygiene and Correction with the state of Ohio.

New officers south of the border who will guide the Mexico Section through 1958 are (left to right): Raul J. Serrano, secretary-treasurer; Hector M. Calderon, president; Leopoldo Farrias S., past-president; and Miguel Montes de Oca, vice-president.

At its recent annual banquet, the Fairbanks Branch of the Alaska Section installed 1958 officers. Shown here are Dr. E. F. Rice, master of ceremonies; T. Hugh Wilson, vice-president; William W. Mendenhall, secretary; Conrad G. B. Frank, past-president; and Harold R. Peyton, new president.

St. Louis Section was host to ASCE President Louis R. Howson at its March meeting. Mr. Howson addressed members on the need for professional unity. Greeting him (in usual order) are: Irwin A. Benjamin, treasurer; Henry S. Miller, first vice-president; Verner C. Hanna, Section president; Erwin E. Bloss, second-vice president; W. W. Horner, Past-President of ASCE; Mr. Howson; Robert D. Bay, secretary; and ASCE Director William J. Hedley.



Mid-South Section's Little Rock Branch has elected 1958 officers. Seen here, left to right, are John W. Couter, vice-president; W. Dewoody Dickson, Jr., president; Joe L. McKinstry, secretary-treasurer. (Photo courtesy of "Construction News," Inc.)

New officers of Central Ohio Section, installed in December, are (left to right) J. W. Dudley, secretary-treasurer; Robert F. Baker, second vice-president; Roy T. Underwood, president; Charles B. Smith, retiring president; O. H. Jeffers, first vice-president; and Robert Duis, retiring second vice-president.

Cleveland...
...uses Pratt Valves in a tight spot

City installations, with limited clearances and traffic problems, are never easy. This Cleveland project, tying a new booster station into two distribution lines, is about as tough as they come.

Here the specifications could not call only for "dependable valves" . . . it had to be "*dependable valves that are easy to install.*" This is where the engineer and contractor can tap the benefits of Pratt's long experience . . . major features of Pratt Butterfly Valves include exactly those things that simplify difficult jobs: minimum head room, versatile operators that can be buried without vaults . . . and design and construction such that the valve will always be easy to open or close.

If you would like to know more about Pratt Butterfly Valves, 40 page manual B2P is yours for the asking. *Henry Pratt Co., 2222 S. Halsted St., Chicago 8, Ill.* Representatives in principal cities.

HENRY PRATT

RUBBER SEAT **Butterfly Valves**

Old and new Carquinez Strait Bridges. Total length of new span is 3,350 feet, four lanes wide. New south cantilever section and part of suspended span appear in foreground at left. Work on north tower, at far right, is in progress. Designer: California Division of Highways. Fabricators and Erectors: American Bridge Division, United States Steel.

Going up:

The Bridge in which "T-1" Steel saved $800,000

The Carquinez Strait Bridge is the first major bridge use of USS "T-1" Constructional Alloy Steel, the first large bridge in which all truss members were fabricated by welding, and unique in that the specification of an alloy steel saved $800,000 in construction costs alone.

Like its 31-year-old counterpart, it will connect the San Francisco Bay area with the Sacramento Valley. In profile, the two bridges look like twins, but are vastly different in construction. First, to build the wider, heavier bridge without exceptionally massive members, a weldable, tremendously strong steel was needed. USS "T-1" Steel's yield strength (90,000 psi minimum), combined with its weldability, filled the bill—cutting weight of some members by nearly one-half their equivalent A242 design, and saving $800,000.

Second, welded construction in the new bridge will greatly minimize maintenance expense. It costs about $70,000 yearly to clean and paint the old bridge. By getting rid of thousands of vulnerable rivet heads, edges, lacing bars and angles in the new bridge, members will be less susceptible to corrosion and far easier to maintain.

All in all, 2,910 tons of "T-1" Steel are used in the bridge's most heavily stressed members. Also used: 5,370 tons of USS Tri-Ten Steel, a weldable high-strength low-alloy steel, and 6,440 tons of structural carbon steel. Each of these steels—all available from United States Steel—plays an important role in the bridge, helping to make possible the "most bridge for the money."

For more information. Write for our comprehensive books entitled "T-1" and "TRI-TEN." You'll find in them a wealth of engineering and metallurgical data. Or, contact our nearest representative—you'll find him listed in the telephone directory. United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

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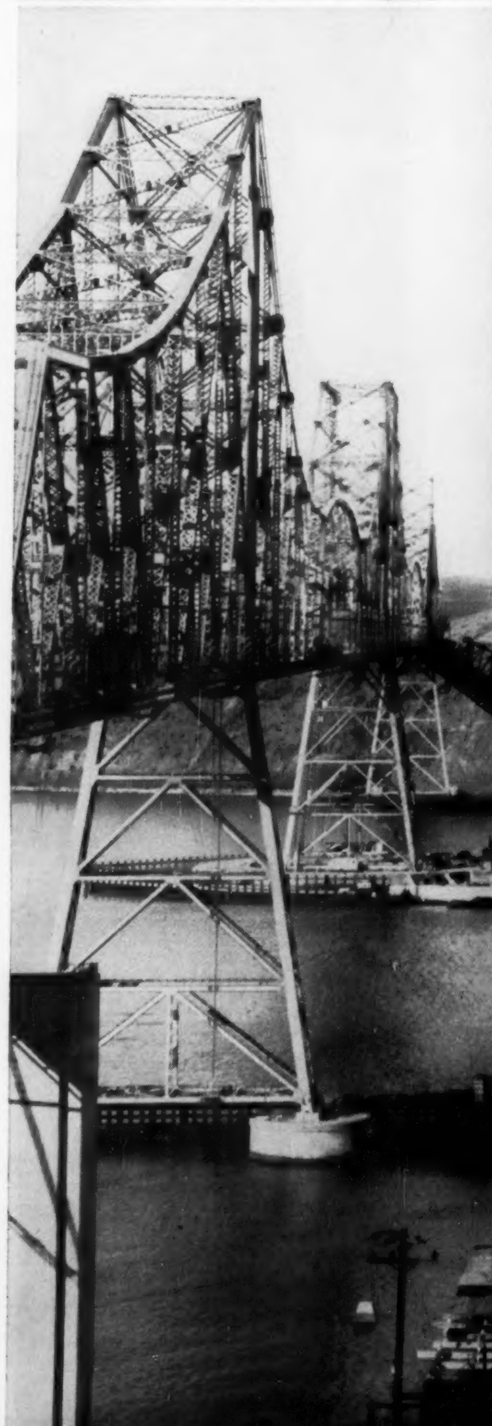
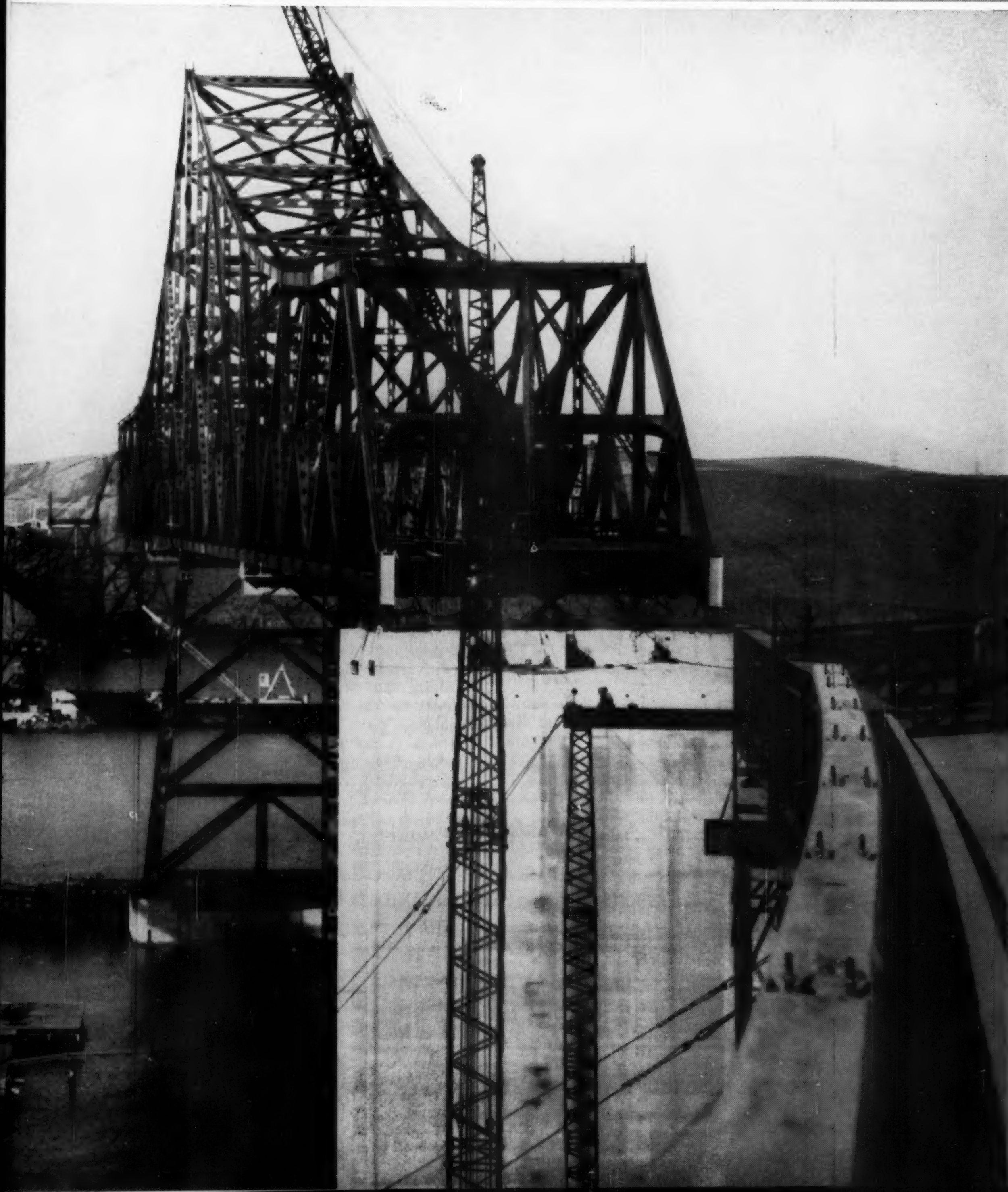


Three things make the new Carquinez Strait Bridge unique in bridge engineering: first, the use of USS "T-1" Steel; second, the use of shop-welded truss members; third, the exclusive use of high strength bolts for field connections.



BY-LINE WASHINGTON . . . . .

A businesslike Congress is fashioning a host of remedial measures to shore up America's slightly ailing economy these days. And much of the strategy is of direct interest to the nation's civil engineers. A clamor of disagreement attends every discussion of tax cuts to loosen the gears of U.S. business. So the attention of Congressmen has been more and more often focused on public works projects as a second-best means of shooting some federal money into the veins of the body economic.

Such tactics, when or if they succeed, will toss into the laps of construction engineers a production problem the like of which they have not seen since the war. For those in public office, particularly, the legislation recently passed or now shaping up in Washington will mean harder work and longer hours than they have seen for a long time.

Here's where some of the new responsibilities will come from:

- An unprecedented $7.7-billion highway construction bill now on the President's desk and expected to be signed.

- Multi-billion-dollar community facilities bills which would open the federal treasury for projects in literally hundreds of communities—new sewer systems, new water plants, new streets, new hospitals, schools and libraries.

- A $2-billion Rivers and Harbors omnibus bill, also just passed by Congress and in the White House.

- A grand step-up of military construction, as the Corps of Engineers attempts to place hundreds of millions of dollars worth of construction under contract by July 1.

By the time this is read most of these programs will probably be rolling down the track under a full head of steam.

* * *

Washington observers feel that President Eisenhower cannot afford to veto the highway bill, even though it contains some features highly objectionable to the political philosophy of his advisers. It pours some $700 million of federal dollars into the economy (which the Administration insists should be allowed to recover by itself as much as possible); it ruptures the traditional 50-50 matching relationship with the states by requiring Uncle Sam to put up 67 percent of the cost of some projects; and it wipes out the pay-as-you-go philosophy originally imposed on the $40-billion Interstate System. It is, however, the most popular of all the anti-recession schemes with the public. Here are the major features:

1. It authorizes the "emergency" distrubution of $400 million for roadbuilding on the regular federal-aid systems (primary, secondary, and urban). This money can be used to provide two-thirds the cost of a project, the state supplying the other one-third. Congress stipulated that the funds be made available at once and that projects be under contract by December. Furthermore, projects must be geared to completion by the following December. Congress also set up a $115-million loan fund from which states could borrow to meet their matching requirements.

2. It boosts the authorization for Interstate System projects by $200 million in fiscal 1959 and raises the authorization for 1960 from $2.2 billion to $2.5 billion.

3. It authorizes another increase in federal grants for the regular highway systems, lifting that outlay to $900 million in 1960 and again in 1961.

4. It provides $112 million annually in 1960 and 1961 for the public-domain roads which run through national parks and forests. [This bill was signed by the President on April 16.]

Highway officials will be under tremendous pressure to put these vast sums to work. And consulting engineers probably can expect that the flow of work they have enjoyed from state highway departments will increase.

* * *

The community facilities program has been seized as another anti-recession lever. In the House, Congressman Rains' plan to lend $2.5 billion to local communities for construction of many types is very much alive. In the Senate, Senator Fulbright's $1-billion program for much the same kind of public works has been bulldozed through committee, and a thorough discussion and vote by the whole chamber is expected momentarily.

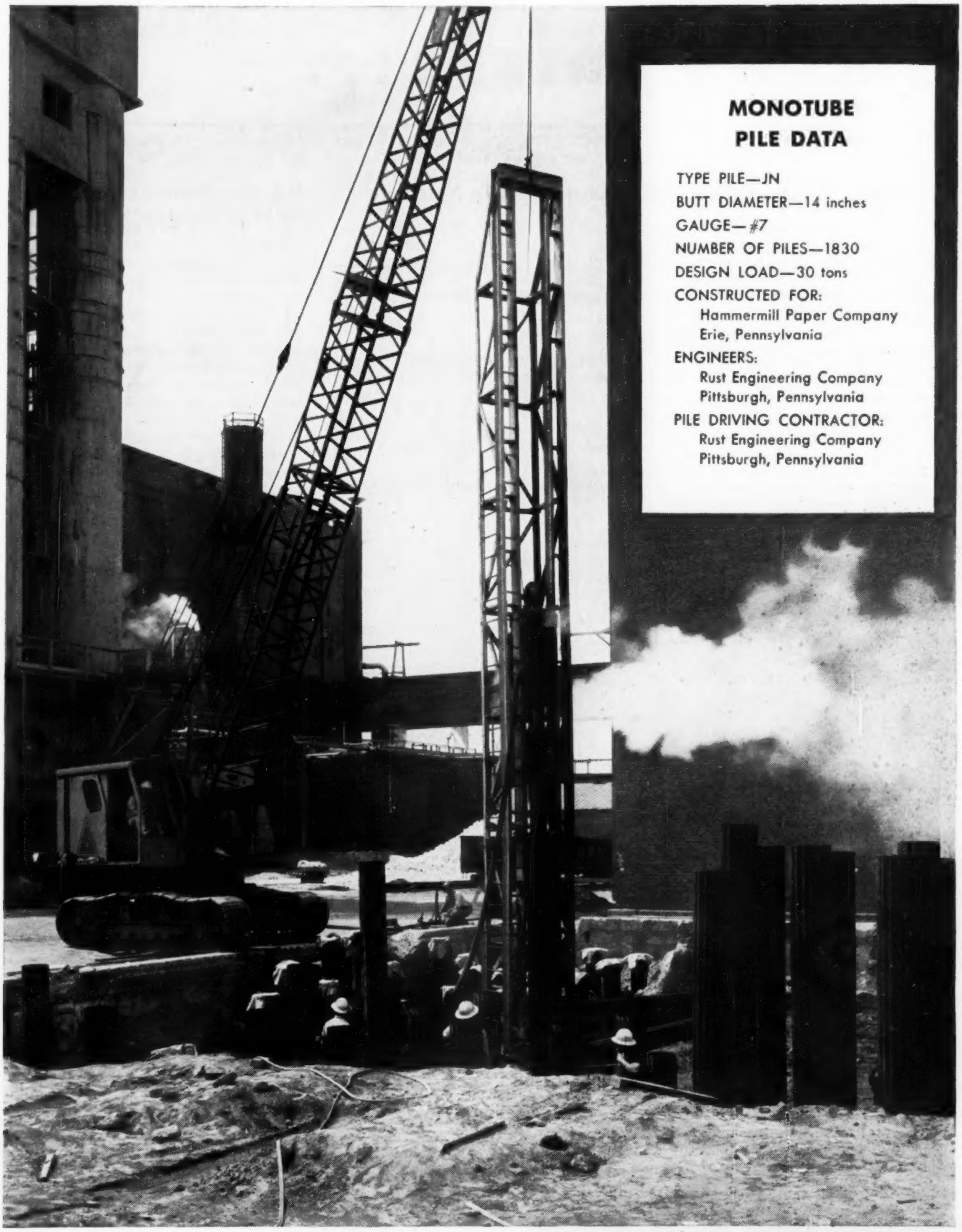
* * *

Meanwhile, the military has been given the go-ahead after a long period under "hold fast" orders, and engineers are rushing plans off the drafting boards. The Department of Defense now plans to increase its construction spending to an annual rate of $5 billion between now and July 1. Only $315 million worth of work had been obligated as of February 1, and the Department had more than $1.7 billion unspent (on that date) for the fiscal year to end within the next two months.

The fate of the big Rivers and Harbors omnibus bill rests with the President. Two years ago, he vetoed a measure similar to the $2 billion program Congress drafted and passed last month. [This bill was vetoed by the President on April 15.]

* * *

A new film designed to impress high school boys with the opportunities in engineering is winning considerable applause around the country. "The Constructors," a 17-minute color motion picture, issued last month by the Associated General Contractors of America, is the national organization's most direct step to inspire the interest of teen-agers in construction careers. It attempts not only to glamorize the challenge and achievements of the profession, but also to point out the educational preparation required. AGC reports the movie will be available for free showings through its 130 local chapters.



DEPENDABILITY plus ECONOMY with Monotube piles. Fast installation of over 1800 Monotube foundation tubes is the progress report on this plant addition for Hammermill Paper Co., Erie, Pennsylvania.

Tapered, fluted Monotube piles are available in lengths, diameters and gauges to meet every requirement. Write The Union Metal Manufacturing Co., Canton 5, Ohio, for complete information.

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Monotube Foundation Piles

NEWS BRIEFS . . .

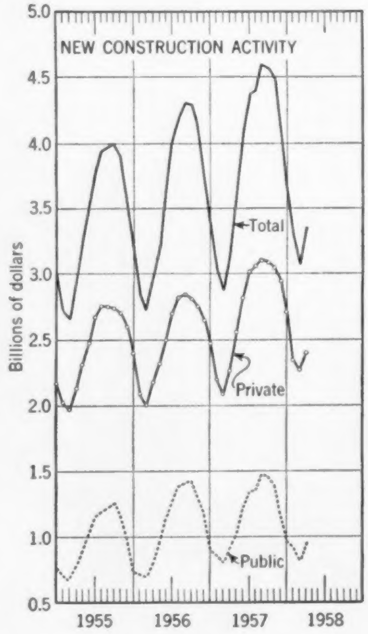
Construction Activity Rises Seasonally in March

The dollar value of new construction put in place in March rose seasonally to approximately $3.4 billion, bringing the first-quarter total to $9.7 billion—slightly above the total for the first quarter of 1957, according to preliminary joint estimates of the U.S. Departments of Commerce and Labor. However, the physical volume of new construction for the first quarter probably has not risen over the same period of 1957.

The latest quarterly estimate reflects a 7 percent rise in public construction from the same quarter of 1957, primarily as a result of rising expenditures for public housing and highways. Private construction outlays in this past quarter were unchanged from the comparable quarter of last year, with residential building accounting for the same portion of the private total in both periods.

These monthly estimates are based largely on past contract award movements, standard progress patterns, and assumed normal seasonal movements. They do not reflect the effects of varying numbers of working days in any given month, such as unusual weather, materials shortages, overtime, work stoppages, and postponements.

Other month-to-month measures of current activity are employment, hours of work, and unemployment. Also indicative of future trends in activity are housing starts, contract awards, building permits, and materials output. Analyses of trends of activity must consider all these interrelated factors.



Seasonal rise in construction in March brings dollar value of new construction for first quarter to $9.7 billion, slightly above 1957 total for same period.

U.S. Ore Production At High Level in 1957

Domestic iron ore production in 1957 came to 118,000,000 tons, according to preliminary estimates of the U.S. Bureau of Mines. This total represented an increase of 8,000,000 tons over 1956 and made 1957 the fourth highest production year in history.

About 80 percent of our iron ore supply came from the Lake Superior region, with Minnesota and Michigan in the lead. Western states, principally Utah, California, and Texas, accounted for a record 11,000,000 tons, a 20 percent increase over the previous year. Alabama supplied most of the South's 7,000,000 tons, while production in the Middle Atlantic states of New York, New Jersey, and Pennsylvania totaled a record 6,000,000 tons.

Last year the United States also imported about 37,800,000 tons of ore, setting a record for imports for the fifth consecutive year. Canada and Venezuela together supplied almost three-quarters of our imports. Other important sources were Chile, with 3,100,000 tons; Peru with 2,600,000 tons; and Brazil and Liberia, with over 1,000,000 tons each.

In the meantime, American steel and mining companies continue to explore and develop foreign sources, particularly in Canada and Venezuela. Construction of plants has been started at Moose Mountain, Ontario, and at Mont Wright and the Ottawa River, Quebec. In Venezuela a new body of ore, known as El Trueno, is being developed south of the Orinoco River. Shipments from this mine are expected to start in 1959.

Columns for New York City Skyscraper

Some of the largest skyscraper columns ever built are being fabricated at the Pottstown, Pa., works of the Bethlehem Steel Co. They are designed for use in the 60-story Chase Manhattan Central Office Building, now under construction in New York City's financial district. These huge column sections will comprise about 50 percent of the 50,000 tons of structural steel required for the building. With maximum lengths of 36 ft and weights up to 52 tons, the individual laminated column sections are made up primarily of plates, up to 52 in. wide and an inch thick, riveted together. This photo gives an idea of the size of the plate columns.

Computer Service Made Feasible for Small Firms

How can small engineering firms avail themselves of the advantages of an electronic computer? Obviously there are many firms that need the occasional use of a computer but cannot afford even the cheapest machine, and in any case, don't have enough work to justify buying one. Recourse to the established computer centers is likely to prove inefficient because of the travel time entailed and the unfamiliarity of the computer center personnel with the precise problems involved.

A solution to the problem has been found by seven Illinois engineering firms, in the Decatur area, which have formed a computer service of their own on a cooperative basis. The cooperative venture, incorporated as the Midwest Computer Service, allows the seven firms to continue in friendly competition while giving stiffer competition to the larger firms.

Major assets of the corporation are a Bendix G-15D, leased from the Computer Division of the Bendix Aviation Corporation; an office in Decatur, Ill.; and a staff of five including a programmer, an operator, and a secretary. The Bendix, which sells for $50,000, is about the size of a soft-drink vending machine.

Stock in the Midwest Computer Service is divided equally among the seven firms, each of which has agreed to purchase enough time on the machine to assure the first year's budget. When the computer is not in use, it may be made available on a fee basis to industries in the area. Inquiries about renting it have been received from utilities and manufacturing and processing plants.

The seven participating firms, which have from 40 to 120 employees each, are: Homer L. Chastain and Associates and Warren and Van Praag, Inc., Decatur; Goodwell Engineers, Inc., Salem; Daily and Dietz, Urbana; Murphy and Tilly, and Jenkins, Merchant, and Nankivil, Springfield; and Hurst-Rosche, Inc., Hillsboro. E. M. Chastain is president of the corporation.

New York City Calls for Computer Service Bids

When New York City recently found itself requiring the brief use of a computer to perform a calculation required to speed completion of the Harlem River Drive, the Office of the Manhattan Borough President advertised its contract for computer work for public bidding. The particular problem was the design of composite stringers for two elevated highway structures, each approximately 3,000 ft long, as well as for several smaller overpass structures. The design was complicated by the large number of subsurface installations and vast network of electrical distribution equipment in the area.

As a first step toward solving the problem by computer, a contract was drawn up for the preparation of a program, the solution of the problem, and the tabulation of results. This contract was then advertised, and the Service Bureau Corporation was the low bidder.

Once the program was written, the IBM 704 Computer, located at the New York Data Processing Center of the Service Bureau Corporation, calculated the complete design of the 300 composite stringers in just 15 minutes. Without the computer the solution of the complex design problem would have taken 420 hours. The IBM 704 costs $1,417,500 and rents for $25,900 a month.

Philco Corporation's Transac S-2000 is a compact and fast all-transistor data-processing system. This new entry into the digital computer field requires about 400 sq ft of space; plugs into conventional 110-volt, 60-cycle outlets; and consumes 7 to 10 kw of electricity. It features 48 binary digit word length capacity; and operates from a magnetic tape input.

Scientists at the Naval Proving Ground at Dahlgren, Va., use the huge Naval Research Calculator (NORC) for study and design of new weapons, development of guided and ballistic missiles systems, earth satellite computations, and basic research in aeroballistics and hydrodynamics. The complex unit, in operation at the Naval Proving Ground since 1955, was built for the Navy by the International Business Machines Corporation at a cost of $2,500,000. NORC performs over 15,000 complete (three-address) operations per second, including floating-point, self-checking, and automatic address-modification features. Its eight tape units can store 3,000,000 words, each consisting of 16 decimal digits, and can transfer information to and from the main computing unit at the rate of 70,000 decimal digits per second. The internal memory stores 3,600 words with an access time of 8 microseconds. NORC results are printed on microfilm by high-speed printer at the rate of 15,000 characters per second.

Erecting Connecticut Bridge Poses Problems

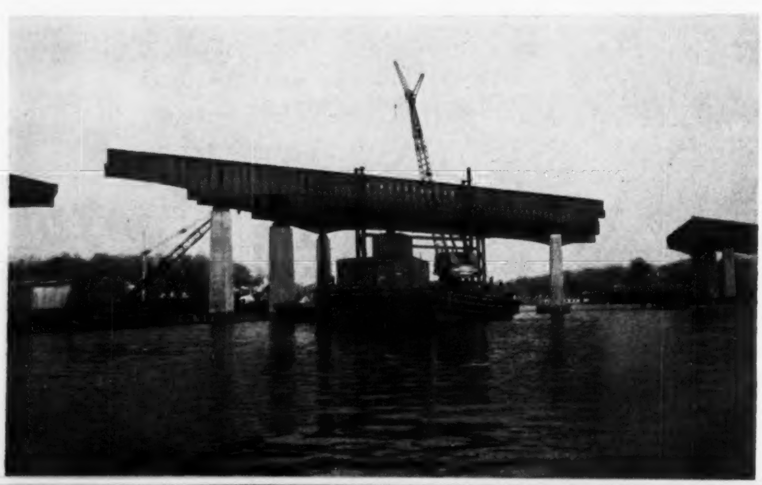
Erecting four main girders of a 37-deg skew bridge over the Mianus River at Cos Cob, Conn., posed some real problems for the J. K. Welding Company, of Yonkers, N. Y., subcontractor to the Poirier & McLane Corporation, for the fabrication and erection of the steel. Falsework could not be used in the navigable channel, which is 100 ft wide, and girders had to span 205 ft to meet the skew and clear the fender system. Girders cantilever an additional 45 ft at each end.

The 295-ft, all-welded girders were assembled in pairs on a barge and transported to the site. Weighing 335 tons with floor beams and bracing, the units were picked up temporarily on other barges, then supported on a pair of 34 × 200-ft railroad car floats for lifting 45 ft to the top of the piers. The car floats were held 6 ft apart and positioned to support the girders on the 37-deg-skew, yet pass through the 100-ft opening. Air-activated 100-ton jacks with a 30-in. rise were used in a frame that permitted step jacking.

Superintendent for the J. K. Welding Company, Inc., was Arthur Miller. Engineer in charge of planning and field procedure was L. H. Stein, who also furnished data for this news brief.

After each 2-ft rise plates were pinned to the frame under the girder. The jacks have power retraction so they pulled their bottom support to the next position. Bracing was placed as raising permitted.

All-welded plate girders span 205 ft between piers and have cantilevers extending 45 ft, which simplifies erection of adjacent spans. The two pairs of girders were separately floated to position at different times, taking advantage of the tide to lower them to the bearings.



Montreal to Have Large Office Building Center

This spring work will start on a large new office building development in downtown Montreal, called the Place Ville-Marie. The real estate firm of Webb & Knapp (Canada), Ltd., has just awarded a $60,000,000 general construction contract for the project to the Foundation Company of Canada, Ltd. Announcement of the award was made by a Webb & Knapp affiliate, the Corporation of the Place Ville-Marie, which has been set up to handle construction and administration of the big project. The contract was said to be the largest ever let by a private company for a Canadian urban improvement project.

The development will be erected on a five-acre tract leased to the Corporation of the Place Ville-Marie by the Canadian National Railways in the area of its central station and recently completed Queen Elizabeth Hotel (August 1957 issue, page 42). The principal structures will be a 40-story aluminum and glass office building in cruciform design; another office building 15 stories high; and a square bordered by shops and a garage. The garage will provide underground parking facilities on three levels for 900 cars. Canadian National Railways will supplement the project with a $15,000,000 administration building adjacent to the Queen Elizabeth Hotel. Preliminary boring and excavating will be started this spring, and the entire project is scheduled for completion within five years.

Leslie W. Haslett, administrative vice-president of Webb & Knapp, has been made president of the affiliate firm. Robert F. McCune, Aff. ASCE, another Webb & Knapp vice-president, will be in direct charge of the work.

Prizes for Papers on Resistance Welding

Six prizes, totaling $2,000, are being offered by the Resistance Welder Manufacturers' Association for the best papers on resistance welding. Entries dealing with the latest developments in projection welding will be entered in a special classification. Papers devoted to developments in all other types of resistance welding (spot, seam and flash-butt, resistance brazing, etc.) will be entered in the general classification. There are three prizes of $600, $300, and $100 in each classification.

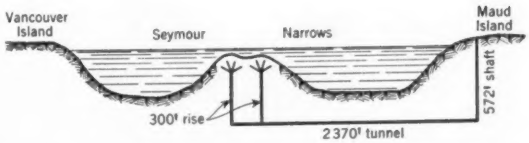
The contest closes September 15, 1958. Application for entry and a brief 100- to 200-word abstract of the projected manuscript are due July 1. Inquiries should be addressed to the Resistance Welder Manufacturers' Association, 1900 Arch Street, Philadelphia 3, Pa.

Ripple Rock, Hazard to Navigation, Destroyed

On April 5 one of the greatest non-atomic blasts ever set off (1,475 tons of explosive) destroyed Ripple Rock, an ancient hazard to navigation in the Inside Passage channel to Alaska between Vancouver Island and the mainland of British Columbia. Rising within 9 ft of the surface in Seymour Narrows 125 miles northwest of Vancouver, the treacherous twin peaks have long been considered the worst threat to shipping on the West Coast. In the past century twenty large ships and more than 100 smaller craft have capsized or grounded while attempting the passage.

Shattering 370,000 tons of rock, the successful blast removed at least 47 ft from the two shoulders of the rocks, and freed a route for shipping in Discovery Passage, an outlet from Vancouver north toward the Pacific. Engineers had hoped to achieve at least a 40-ft channel. According to Ferdinand D. Bickel, Du Pont blasting expert, the big problem was to throw the rock to the sides and overcome the tremendous resistance of the water, so that dredging would not be necessary. To assure throwing the rocks in the right place, the peaks were loaded with about eight times the normal charge for underwater blasting.

Previous efforts to remove Ripple Rock had failed. Twice it was attempted by mooring barges above for submarine drilling and blasting. The barges could not be held in the swift current.



To place explosives in the peaks, 2,400-ft tunnel was driven under Ripple Rock in the Inside Passage to Alaska. Explosives in coyote holes branching out from rises at left were then exploded to move 325,000 tons of rock from the twin peaks.

This time the peaks were attacked from underwater through a $3,100,000 tunneling project. A vertical 570-ft shaft, 12 by 18 ft, was sunk on Maud Island, on the east bank of the Narrows. An 8-ft-square tunnel was then driven in solid rock, 2,400 ft out under the water. From the tunnel 300-ft vertical rises were excavated into each rock peak. The peaks were then honeycombed with smaller tunnels and coyote holes, which were filled with "Nitramex" 2H—a Du Pont blasting agent of high strength and resistance to dampness.

The blast was triggered from a bunker half a mile away by Dr. Victor Dolmage, Canadian mining engineer, who planned the project for the Canadian Department of Public Works. The construction work was handled by the Northern Construction Company & J. W. Stewart, Ltd., of Vancouver, Canadian affiliate of Morrison-Knudsen, with Boyle Brothers Drilling Company, Ltd.

Iraq Awards Major Foundations Contract

A subcontract to drive more than 3,000 steel pipe piles for piers and grain silo foundations in Iraq has been awarded to the Raymond Concrete Pile Company. The project—sponsored by the Grain Board of Iraq's Ministry of Economics—involves construction of four large groups of grain silos and associated pier facilities on the Shatt Al Arab, about 100 miles upstream from the Persian Gulf at Basrah.

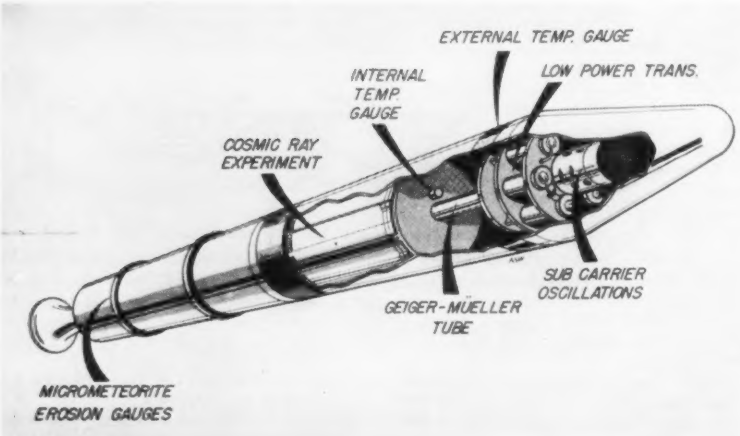
The major part of the contract will be the driving of nearly 2,500 tightly spaced piles for the group of silos. These piles, which are 20 in. in dia and 90 ft long, must be placed in an area only 580 ft long and 100 ft wide. To overcome the problems caused by the tight spacing and the unstable clay soil, the company will have to pre-excavate each hole before driving. A drill mounted on the side of the pile-driver leads will excavate the hole while a jet of water discharging through the center of the bit will wash cuttings to the surface.

The general contractor is the joint-venture German firm, Ed Zublin-A. H. T.-Bau. The engineers are Tippetts-Abbett-McCarthy-Stratton, of New York. Pipe will be supplied by the Foster International Corporation, Houston, Tex.

Historic Ohio Road to Be Part of Interstate System

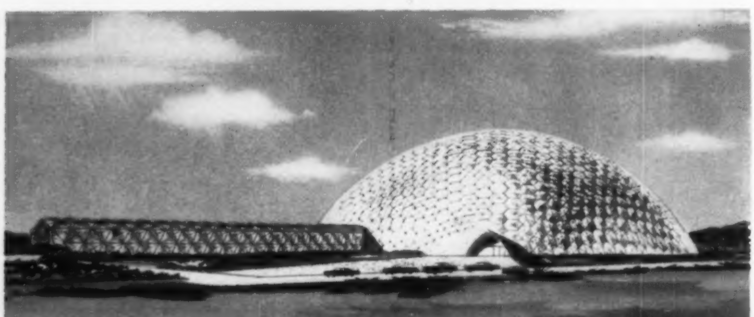
Historic U.S. 40, which crosses Ohio from West Virginia to the Indiana border, will be a vital link in the new national highway system. By 1969, when it has been rebuilt and improved to meet the new interstate standards, it will be a 230-mile non-stop highway. Originally a path through the woods made in 1796 for postal riders, U.S. 40 has been known as Zane's Trace and the National Road. In 1969 it will be redesignated Interstate Route 70. When work currently under way is completed, all but 75 miles of Route 40 will be a modern four-lane highway. A partial clover-leaf interchange at State Route 69 in Montgomery County is shown in this aerial view.

Explorer III Features Improved Signaling



Artist's sketch reveals compact interior of the third Army satellite, Explorer III, successfully launched by the Army through the Army Ballistic Missile Agency and the California Institute of Technology Jet Propulsion Laboratory. Instruments for investigating cosmic rays are contained in the encapsulated package, which also holds the high-power transmitter and magnetic tape recorder. In this satellite the turnstile antenna, used in Explorers I and II, has been replaced by a dipole antenna, in which the satellite itself is the antenna. Use of the dipole antenna eliminates the problem of oscillation and improves signaling. In 5 seconds the high-power transmitter relays to ground stations information collected on the magnetic tape recorder over a two-hour period. Transmission is triggered by a coded command radio signal from the ground.

Ten-Story Dome Built Without Internal Supports



All-steel geodesic dome—said to be the world's largest building without internal supports—is shown here in artist's rendering. The ten-story structure, which is being built in Baton Rouge, La., by the Union Tank Car Company of Chicago, is 375 ft in interior base diameter and 116 ft high at its center. It will consist of 320 steel panels fabricated on location in twelve basic sizes and welded together. A 200-ft-long tunnel-shaped paint building, made of similar steel panels, connects with the main repair shop area. Though the cost of the dome and its facilities is estimated at more than $1,000,000, it is said to be significantly less than that of the conventional car repair plant of its size. Designs for the dome are based on patents held by R. Buckminster Fuller and developed by his firm, Synergetics, Inc., of Raleigh, N. C. The project will be finished this year.

ASTM Committees Propose New Standards

Some 1,100 members of the American Society for Testing Materials met in St. Louis, February 10-14, for the annual ASTM Committee Week program. In 280 committee and subcommittee meetings, the experts discussed and correlated the research upon which ASTM specifications and methods of test are based. The committees also put into final shape new and revised tentatives and standards, which will be recommended to the ASTM for adoption at its annual meeting in Boston, June 22-27. Two of the committees held open meetings featuring symposiums.

Precision of test methods as determined by statistical analysis of test data was featured in the recommendations of ASTM Committee D-4 on Road and Paving Materials. Recommendations covered five new methods of test for: (1) resistance to deformation and cohesion of bituminous mixtures; (2) kneading compaction for bituminous mixtures; (3) resistance to plastic flow of bituminous mixtures using the Marshall Apparatus; (4) resistance to deformation and cohesion of bituminous mixtures using the Hveem Apparatus; and (5) compaction for bituminous mixtures using the California Kneading Compactor.

A proposed new method of test for the determination of shrinkage of masonry units during drying will be submitted to the ASTM for adoption on the recommendation of Committee C-15. The committee also completed the first phase of work on a test to determine the effectiveness of waterproofing coatings for unit masonry walls and advanced its work on numerous other testing methods including those applying to clay and sewer brick. Concrete-block shrinkage during drying is a matter of primary concern to the concrete masonry industry.

After eight years of trial as a tentative standard, the ASTM Method of Fire Hazard Classification of Building Materials (E 84), commonly known as the "tunnel test," will be submitted for adoption as a standard, Committee E-5 announced. The committee also reported that there are now four tunnel installations in the United States and Canada for making these tests. The committee also advanced its work on test procedures involving smaller and less expensive equipment for use in evaluating the flame-spreading characteristics of building materials.

Standards for steel for concrete reinforcement continue to receive much attention from Committee A-1. In 1957 two new specifications—one for large deformed billet steel bars (A 408) and another for uncoated seven-wire strand for prestressed concrete (A 416)—were published. A new specification for uncoated wire for prestressed concrete will

be submitted for adoption in June. In addition, work started on a new specification for high-strength billet steel reinforcement with a yield strength of 75,000 psi.

Also of interest to civil engineers was the Symposium on Mortars, sponsored by Committee C-12 during the week-long program. Workability and the proper selection of materials were stressed as the two most important factors in obtaining good masonry in the seven papers comprising the symposium. Bond strength was also emphasized as an important property.

Tainter Gates Fabricated for Brownlee Dam

Tremendous size of the four tainter gates being built for Brownlee Dam in Hell's Canyon is shown in this photo taken at the plant of Gate City Steel of Boise, Idaho, fabricator of the structures. The gates, each with a weight of 120 tons, are over 31 ft wide. The arms are made of 14-in.-wide flange beams. With the trunnion, they measure over 50 ft in length. After assembly at Gate City Steel, the gates will be dismantled for shipment by rail to the dam site. They will be installed by Morrison-Knudsen, the general contractor. Brownlee Dam is a project of the Idaho Power Co.

AAAS Invites Fellows From ASCE Membership

Members of ASCE who are also members of the American Association for the Advancement of Science automatically qualify for elevation to fellowship in the AAAS. It will be appreciated if ASCE Members who are currently AAAS members but do not have a fellowship certificate will advise the AAAS to that effect. Correspondence should be sent to Mr. Raymond L. Taylor, Associate Administrative Secretary, AAAS, 1515 Massachusetts Avenue, N.W., Washington 5, D.C.

Long-Range Need for Engineers Foreseen

Engineers will be among the first groups to benefit from attempts to halt the recession, according to Howard L. Bevis, chairman of the President's Committee on Scientists and Engineers. In a leading talk given at the recent two-day New Jersey Conference on Utilization of Scientists and Engineers, held at Rutgers University, Dr. Bevis told the delegates not to confuse temporary recession setbacks with the long-range trend. He sees the increasing population and ever-rising standard of living as deterrents to a prolonged recession.

Nearly all the recovery programs planned will require engineers and technicians, Dr. Bevis said. He expects that "their hiring will come relatively early as plans are drawn, specifications approved, technical staffs built up, and preparations made for production or construction."

The New Jersey Conference and some 50 others like it in all parts of the country were planned at the request of the President's Committee to seek ways of making maximum use of the existing supply of scientists and engineers. Elmer C. Easton, dean of the Rutgers College of Engineering, was conference chairman.

R. ROBINSON ROWE, M. ASCE

The May meeting of the Engineers Club, dedicated to Hightronic Computer Week, was a show of the mathematical magic of the highway engineers. The Professor looked worried as he took his cue.

"No mistakes, please," he warned Joe Kerr, "or you'll be replaced by a machine. Your problem was to locate the best cut-off fence running due east from the diagonal freeway."

"Like SC on the map. The saving is the cost of fence omitted, SQ, less the cost of fence added, SC, both at f cents per ft, less the cost of triangle SQB which must be acquired at one cent per sq ft. In terms of u = QC and the given angle Θ, the saving is

$$S = fu\,(\csc\Theta - \cot\Theta) - \tfrac{1}{2}u^2\cot\Theta \quad (1)$$

To make this a maximum, sister Fay helped me zero the differential

$$dS/du = f\,(\csc\Theta - \cot\Theta) - u\cot\Theta = 0 \quad (2)$$

$$u = f\,\mathrm{exsec}\,\Theta \quad (3)$$

$$S_{min} = \tfrac{1}{2}f^2\cot\Theta\,\mathrm{exsec}^2\,\Theta \quad (4)$$

With $\Theta = 45°$ and f previously found equal to $100\,(\sqrt{3}+1)$, $u = 113.16$ ft and the saving is \$64.03. HowmIdoin?"

"Splendid. Keep it up and the Juniors will be calling you 'Mr Kerr' and Cal—well let's see first if he did as well with his problem of locating the best curved fence."

"The Juniors can still call me 'Mr Klater'," bragged Cal. "The best fence follows some arc RC with an unknown shape y = F(x) for which the saving in cost is

$$S = f\,(RQ - RC) - \text{Area (QRC)}$$

(Continued on page 106)

(Continued from page 105)

$$= fa \sec \theta - \tfrac{1}{2}a^2 \tan \theta - \int_a^0 \left(y + \sqrt{1 + y_1^2}\right) dx \qquad (5)$$

where a is the abscissa of R and y_1 is dy/dx. Minimizing the integral by the calculus of variations,

$$y = \sqrt{f^2 - x^2} - f \sec \theta \qquad (6)$$

$$S_{min} = \tfrac{1}{2}f^2 (\tan \theta - \theta) \qquad (7)$$

This curve is a circular arc with radius f tangent to RQ and normal to CQ, saving $80.09."

"Fine and dandy," agreed Professor Neare. "Your curve is also tangent to Joe's best normal fence SC, to the best straight fence PB, which saved $73.20, and, more generally, to the best line for any given azimuth, so the 'best' lines are one big happy family. As soon as the hightronic engineers have programmed equations 3, 4, 6 and 7, we're in business.

"Our new problem illustrates the impact of computers on the personnel problem generated by the expanded highway program. The Calizona Highway Department handled its $50 million program in 1956 with a staff of 39 engineers and 37 technicians using one hightronic computer. For its $100 million program in 1957, it bought two more computers and recruited one engineer and 23 technicians. This year its $200 million program is on schedule with the help of 4 new machines, 5 more engineers and 35 more technicians. To exactly take care of a $400 million program in 1959, how few new men must be recruited?"

[Cal Klaters were Ed C. Holt, Jr. and Sauer Doe (Marvin Larson). The best curve can be found by better known methods than the calculus of variations, but a full explanation is too long for the column. Also acknowledged are solutions to the February problem of the starving xabs from Paul H. Sanders and Thatchrite (Guy C. Thatcher).]

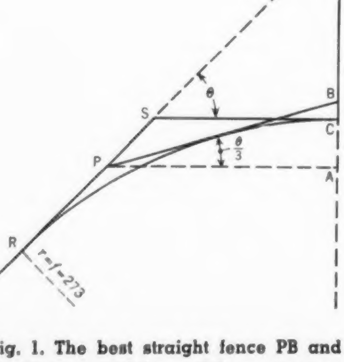
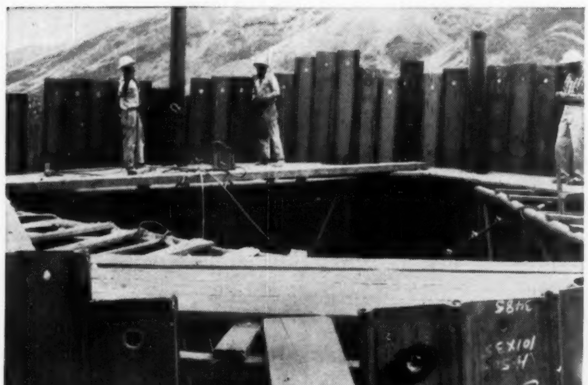


Fig. 1. The best straight fence PB and the best normal fence SC are tangent to the best curved fence RC.

4,665 tons of USS Steel Sheet Piling are being used to construct this huge cofferdam, by the prime contractor Merritt-Chapman & Scott Corp. of New York, to divert the Columbia River in the building of Priest Rapids Dam.

USS Steel Sheet Piling helps change Indian territory into an industrial district



Close-up of one cell of the cofferdam showing tight interlocking piling driven around a template.

News of Engineers

(Continued from page 23)

Elwyn W. Simpson has joined the Merritt-Chapman & Scott Corporation, New York contractors. Formerly Mr. Simpson held the position of construction manager for the Perini Quebec Company of Montreal.

Henry W. Hemple is the recipient of the 1958 Distinguished Service Award of the Alumni Association of the Illinois Institute of Technology. The award is given for outstanding contributions to the fields of science and technology. At the time of his retirement in 1952, Captain Hemple was serving as chief of the Geodesy Division after a long career with the Coast and Geodetic Survey.

H. W. Hemple

R. A. Harris has accepted a position as engineer-manager for the Mississippi Road Builders Association in Jackson. Mr. Harris has served as technical adviser on highways for the Ministry of Public Works in Bogota, Colombia, for the past four years.

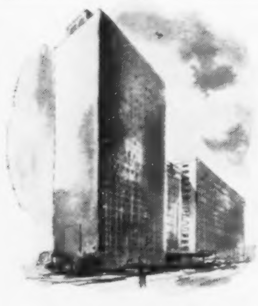
Thomas P. Collier has been awarded a Certificate of Service by Secretary of Commerce Sinclair Weeks. The award was given for Mr. Collier's "exemplary voluntary service" with the U.S. Trade Mission to the Netherlands last year. He is vice-president of Bruce Payne & Associates, Chicago.

Earl R. Bennett, Captain Civil Engineer Corps, U. S. Navy, has been transferred to Newport, R. I., where he will serve as public works officer. Captain Bennett had been stationed previously in Washington, D. C., with the Bureau of Yards and Docks.

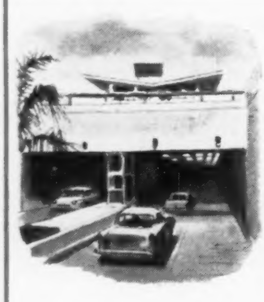
E. R. Bennett

Ernest R. Schultz has been appointed head of the Concrete Dam Section in the Bureau of Reclamation's Denver office. Prior to this promotion, Mr. Schultz had served as supervisory civil engineer with the Bureau. He is a member of the U.S. Committee on Large Dams.

(continued on page 116)



DETROIT CITY-COUNTY BLDG.
ON RAYMOND FOUNDATIONS



TUNNEL, HAVANA, CUBA
CONSTRUCTED BY RAYMOND

JEFFERSON MEMORIAL, WASHINGTON, D. C.
ON RAYMOND FOUNDATIONS

CANIMAR RIVER BRIDGE, CUBA
CONSTRUCTED BY RAYMOND

News of Engineers

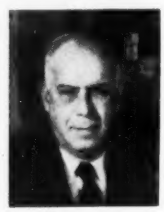
(Continued from page 110)

Philip M. Grennan, associate with Alfred Easton Poor, New York architect, has been named, together with his firm, as winner of the New Jersey Prestressed Concrete Manufacturers Association award for having designed the best structure in the state, utilizing precast and prestressed concrete, during 1957. The building for which the award was made is the Book Distribution Center of the McGraw-Hill Publishing Company, Inc. in Hightstown, N. J. The building was designed by the Poor firm. Mr. Grennan will receive an all-expense paid trip to West Berlin to attend the World International Convention and Conference on Prestressed Concrete.

P. M. Grennan

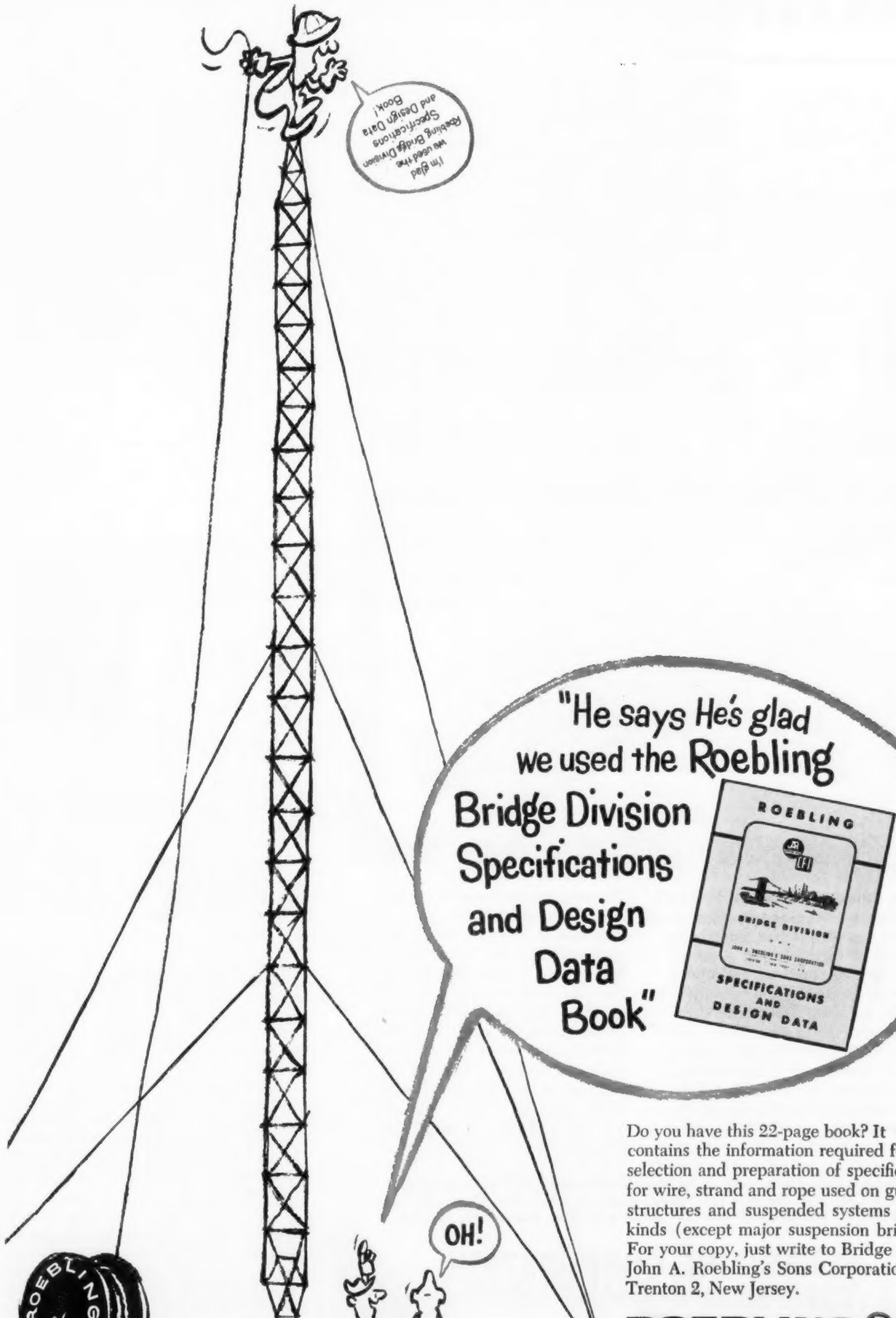
K. N. Cundall has accepted an appointment as president of International Bitumen Emulsions Corporation in San Francisco, Calif., a subsidiary of American Bitumulus. Mr. Cundall has served American Bitumulus and its branches in a number of capacities since 1944.

Morris Goodkind, director and chief bridge engineer of the State Highway Department of New Jersey, has been awarded the 1958 Egleston Medal. This award is Columbia University's highest recognition of "distinguished engineering achievement." Mr. Goodkind has served as state bridge engineer since 1925. He is a former Director of ASCE.



Morris Goodkind

Six ASCE members have been invited to visit the Soviet Union this month. They are: **Boris Bresler,** Engineering Department, University of California; **David P. Billington,** Roberts and Schaefer Company, New York; **James D. Piper,** vice-president, Portland Cement Association; **Walter H. Price,** president of the American Concrete Institute; **Ben C. Gerwick,** president of the firm of the same name in San Francisco; and **T. Y. Lin,** Engineering Department, University of California. The group will spend part of their visit in Moscow and part in Leningrad, and they will have an opportunity to observe Russian research and development in the field of concrete and prestressed concrete.


I'm glad we used the Roebling Bridge Division Specifications and Design Data Book!
"He says He's glad we used the Roebling Bridge Division Specifications and Design Data Book"
ROEBLING
BRIDGE DIVISION
SPECIFICATIONS AND DESIGN DATA
OH!
ROEBLING

DECEASED

Crispin Ayala-Duarte (M. '52), age 65, engineering director for Constructora Ricca, died recently in Barcelona, Spain. Mr. Ayala-Duarte, a Venezuelan, was graduated from the Central University of Venezuela as a doctor of science, physics and mathematics. He had worked on design and construction of a sewer system for Caracas, and taught for some years at the Central University.

Hubert K. Bishop (M. '04), age 87, died on March 9 in Washington, D. C. Mr. Bishop was graduated from Cornell University in 1893 with a degree in civil engineering. He was the first deputy of the New York State Highway Commission and chief engineer of the Indiana Highway Commission. Mr. Bishop engineered the deepening of the Erie Canal in 1896. He had also been Superintendent of Public Works for the Territory of Hawaii and deputy commissioner of the Bureau of Public Works in Washington.

Julian C. Chaderton (A.M. '39), age 63, civil engineer with Frank Miller's Sons Fireproofing Company, died on February 21 in Chicago, Ill. Mr. Chaderton, a graduate of Illinois Institute of Technology, had taught civil engineering at the University of Detroit, Purdue University and the University of Illinois. He joined the Miller firm three years ago.

Edgar S. Closson (M. '16), age 75, retired engineer of Montclair, N. J., died in Orlando, Fla., on March 10. Mr. Closson was graduated from Union College with a degree in civil engineering. He served with the Rapid Transit Commission in New York City as assistant engineer on construction of the East River Tunnel and as section engineer on the Lexington Avenue Subway. During his long career he had also been chief engineer for the Lock Joint Pipe Company; president and chairman of the board of the Closson-Parkhurst Engineering Corporation; and more recently consulting engineer for Parsons, Brinckerhoff, Hall and Macdonald of New York City.

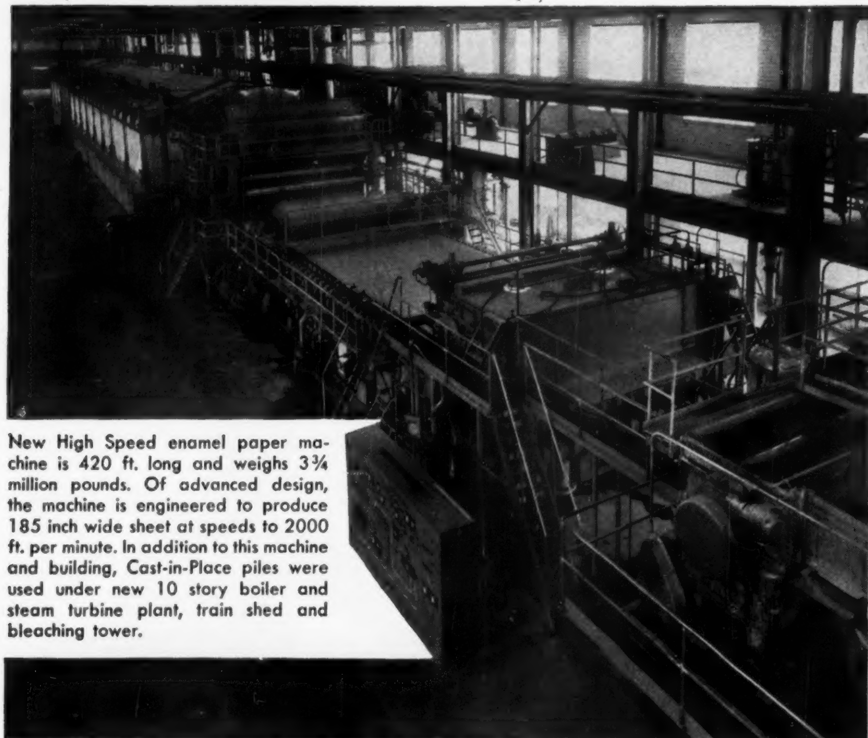
Jeremiah J. Collins (A.M. '14), age 74, vice-president and a director of Raymond International, Inc., New York, N. Y., died on April 14 at his home in East Orange, N. J. Mr. Collins had been with Raymond since 1912, when he joined the company as a construction superintendent. When the company began its first overseas work in the early Nineteen-Twenties, Mr. Collins directed investigations, negotiations and estimates. Since 1952, he had been chairman of the operating committee for a joint-venture construction group, Brown-Raymond-Walsh. This group has been active in the $200,000,000 Navy and Air Force program of building bases in France and Spain, and a 485-mile pipeline for the Navy's Bureau of Yards and Docks in Spain. Mr. Collins was a graduate in civil engineering from the University of Michigan.

J. J. Collins

David Gutman (M. '34), age 78, consulting engineer of New York City, died in Pelham, N. Y., on March 8. Mr. Gutman received his B.S. and civil engineering degrees from Case School of Applied Science. As head of his own structural engineering firm for many years, he designed the footings and framework of over 100 large buildings. He was author of two textbooks for the International Correspondence Schools on wind bracing and contracts, specifications and design drawings.

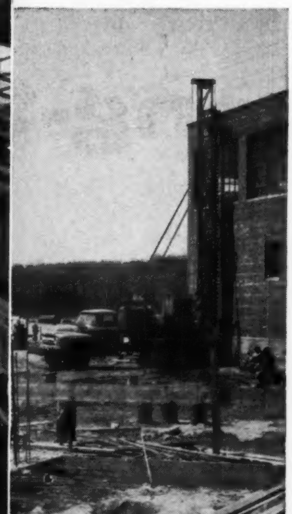
Clarence W. Hanson (M. '45), age 56, partner in Modjeski and Masters, Harrisburg, Pa., engineering firm, died there on March 26. Mr. Hanson was graduated in civil engineering from Iowa State College. He had spent his professional life

(Continued on page 121)

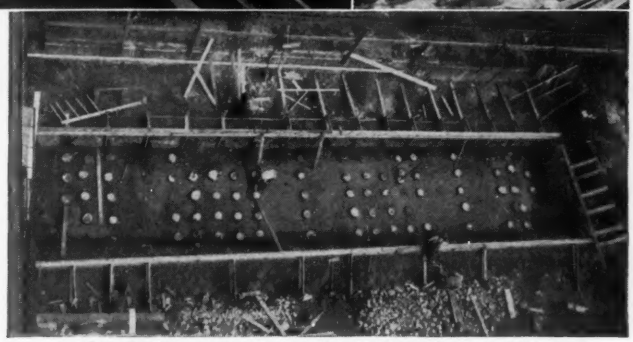


New High Speed enamel paper machine is 420 ft. long and weighs 3¾ million pounds. Of advanced design, the machine is engineered to produce 185 inch wide sheet at speeds to 2000 ft. per minute. In addition to this machine and building, Cast-in-Place piles were used under new 10 story boiler and steam turbine plant, train shed and bleaching tower.

Cast-in-Place rig places pile close to existing building without danger of vibration damage.



paper production boosted on Cast-in-Place piles



Cast-in-Place pile pattern for section of new plant.
(Photos—courtesy Consolidated Water Power & Paper Co.)

In planning new buildings for a 15 million dollar expansion program, Consolidated Water Power & Paper Company was confronted with difficult soil conditions at their Biron, Wisconsin, plant.

Borings indicated the existence of a non-uniform sand, clay, and decomposed granite soil underlain by granite bedrock at irregular depths. A further complication was the periodic rise and fall of the nearby river, causing a fluctuating water table and consequent movement or loss of fines in some areas. Under these conditions, it was considered inadvisable to depend on spread footings for buildings or high-load machine foundations. It was recommended that all loads be transferred directly to bedrock through the use of economical Cast-in-Place INTRUSION mortar piles.

INTRUSION-PREPAKT Cast-in-Place piles offered advantages not obtainable with any other type. Highly mobile equipment permitted operations close to existing buildings without danger of vibration or ground heaving usually associated with driven piling. In areas where soil was not self-supporting, casing was unnecessary because INTRUSION mortar under pressure fills hole as auger is withdrawn. This pressure also provided some lateral penetration to stabilize weak soil zones and increase pile skin friction. In all, some 1300 high-strength Cast-in-Place piles were placed for Consolidated's expansion program that added 230,000 square feet of floor space.

Cast-in-Place piles have a proven record of success all over the world. In addition to foundations, they provide a practical solution to many shoring, underpinning, stabilization and cofferdam problems. For more information on Cast-in-Place piles and other I-P construction services, contact: INTRUSION-PREPAKT, INC., 568-M Union Commerce Bldg., Cleveland 14, Ohio. In Canada, INTRUSION-PREPAKT, LTD., 159 Bay Street, Toronto, Ontario.

INTRUSION-PREPAKT, INC.

OFFICES IN PRINCIPAL U. S. AND FOREIGN CITIES

*Intrusion and Prepakt are trade marks of Intrusion-Prepakt, Inc., whose methods and materials are covered by U. S. Patents Nos. 2313110, 2655004, 2434302 and others, also patents pending.

Deceased

(Continued from page 118)

with Modjeski and Masters which he served as resident engineer on construction of a number of important bridge projects. He had been a partner in the firm since 1947. Mr. Hanson was a commissioned officer in the Corps of Engineers on overseas assignments during World War II.

Howard B. Howie (M. '41), age 78, consulting engineer for the Knoxville (Tenn.) Utilities Board, died recently in Knoxville. Mr. Howie spent most of his professional life in Tennessee. For many years he headed the Roane Iron Works (now the Tennessee Products and Chemical Company) and later was associated with the Fulton Sylphon plant. He had also been with the Tennessee Valley Authority at Muscle Shoals, Ala.

John A. Jacobson (J.M. '52), age 30, soils engineer with DeLeuw, Cather and Company, Chicago, Ill., died on March 12 in LaGrange Park, Ill. Mr. Jacobson had B.S. and M.S. degrees from the Massachusetts Institute of Technology. He had served as foundations engineer with Anderson-Nichols and Company in Concord, N. H., until he joined DeLeuw, Cather and Company a few years ago.

Herbert W. Kueffner (M. '30), age 69, director of public works for the city of Durham, N. C., died there on February 18. Mr. Kueffner, a graduate of North Carolina State College, served as city engineer for Durham from 1914 until 1921, when he was named director of public works. He had been honored by the American Public Works Association for his long and excellent record of public service.

Alfred Liebmann (A.M. '02), age 87, vice-president and treasurer of Liebmann Breweries, Brooklyn, N. Y., died in that city recently. Mr. Liebmann was graduated from Columbia University with a degree in civil engineering. Before joining Liebmann Breweries, he had been in the contracting business in New York City.

Horatio S. Mattimore (A.M. '15), age 76, consulting engineer, died in Hollywood, Fla., on March 3. Mr. Mattimore retired as chief engineer of tests for the Pennsylvania State Highway Department in 1943 and that year was the recipient of the George Bartlett Award for highway engineering. After his retirement, Mr. Mattimore became consulting engineer for the New Jersey Highway Authority, serving as a consultant on the construction of the New Jersey Turnpike and the Garden State Parkway.

H. S. Mattimore

Frank R. Olmstead (M. '46), age 53, research engineer for the U. S. Bureau of Public Roads, died on April 2 in Gravelly Point, Va. Mr. Olmstead was a graduate of Waynesburg College and the University of Michigan. Before joining the Bureau of Public Roads, he served as research engineer with the Michigan State Highway Department, where he was a specialist in soil research for low-cost roads. In February of this past year, he was cited by the Commerce Department "for extraordinary vision and highly effective leadership in the use of geologic, air photo and agricultural soil information in natural road development."

George E. J. Pistor (M. '19), age 78, retired contracting engineer for the Bethlehem Steel Company, in New York City, died on March 23 in Bloomfield, N. J. A long-time resident of Montclair, N. J., where he had been town consulting engineer for the past 38 years, he was instrumental in the revision of the town's building code. In the 1930's, Mr. Pistor served as contracting engineer for the old Hay Foundry and Iron Works, which subsequently was absorbed by the McClintic-Marshall Company. Later the Marshall Company was taken over by Bethlehem Steel Company which Mr. Pistor served in many capacities until his retirement in 1946. He was founder and former treasurer of the American Institute of Steel Construction.

Louis J. Riegler (M. '14), age 85, died recently in Pittsburgh, Pa. Mr. Riegler studied at Duquesne University. He had a record of 45 years of service with the Pennsylvania Railroad Company, and at the time of his retirement in 1945 held the position of assistant chief engineer.

Theodore R. Sucher (A.M. '21), age 74, secretary-treasurer of the New Haven Gas Company, died recently in Hamden, Conn. Mr. Sucher had held a number of responsible posts with the gas company since he joined it in 1903.

James H. Titus (M. '24), age 77, assistant engineer for University City, Mo., died recently in Maplewood, Mo. Mr. Titus, who studied at Ottawa University (Kansas), spent 31 years with the Wabash Railroad Company doing evaluation work. Upon his retirement in 1951, he took the post of assistant engineer for University City.

Everett J. Wendell (M. '46), age 61, for a number of years county superintendent of highways for Peoria County, Ill., died in Peoria recently. Mr. Wendell was the Peoria member of the State Examining Board for Professional Engineers.

(Continued on page 127)

Deceased

(Continued from page 121)

Philip S. Wickerham (M. '28), age 79, retired consulting engineer of Portsmouth, Ohio, died there recently. Mr. Wickerham was a Phi Beta Kappa graduate of Ohio Wesleyan University. He had been engaged in sewage disposal work in Pennsylvania; government work in the Philippines; and as civil engineer for the Roosevelt Lake Park Project in Portsmouth.

William P. Wiltsee (M. '10), age 78, retired chief engineer of the Norfolk and Western Railway Company, died on February 3 in Roanoke, Va. Mr. Wiltsee received his degree in civil engineering from Ohio State University. Most of his professional life was spent in railroad work. He held the post of chief engineer with the Norfolk and Western Company from 1913 until his retirement a few years ago.

RECENT BOOKS

(added to the Engineering Societies Library)

American Power Conference Proceedings
Vol. XIX, 1957

The papers comprising this volume emphasize broad aspects of technical development. A wide variety of topics is presented, including steam and gas turbines, industrial power plants, condensers and feedwater circuits, extra high voltage systems, electrical distribution, computers and network analyzers, nuclear energy, and water technology. (Published 1957 by the Illinois Institute of Technology, Technology Center, Chicago 16, Ill. 746 pp., $8.00.)

An Analysis of the Wood-Cutting Process

This is a study of the machining of wood with saws, surface planers, and coated abrasives. It begins with a description of the experimental procedures and interpretive techniques used, including that of photographic analysis. The results and analysis of observational studies, of tool force studies, and of mechanical properties tests, are then given. A concluding unit discusses the mechanics of chip formation by Norman C. Franz. (Published 1958 for the Engineering Research Institute by the University of Michigan Press, Ann Arbor, Mich. 152 pp., $4.50.)

Analysis Of Multistory Frames
Translated from the Fifth German Edition by C. J. Hyman.

In this book Gaspar Kani emphasizes frames with linearly displaceable joints. An iteration procedure is used that consists of a repetition of the same operation, thereby reducing the probability of a computational error. Aspects discussed include analysis of structures with nontranslatory joints, story frames with joints movable horizontally, separate verification of end moments, influence lines, and structures with bars of variable cross section. (1957, Frederick Ungar Publishing Co., 105 East 24th St., New York 10, N. Y. 113 pp., $4.50.)

(Continued on page 124)

INGALLS

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Over 3,050 tons of Ingalls fabricated structural steel will frame the new Sedgewick County Court House and Welfare Building in Wichita, Kansas.

This smartly-designed twelve-story structure is typical of hundreds of office and commercial buildings, plants and warehouses to which Ingalls has furnished the strength and economy of fabricated structural steel.

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The Ingalls Shipbuilding Corporation, Shipyards: Pascagoula, Mississippi; Decatur, Alabama Sales Offices: New York, Chicago, Washington, Houston, New Orleans, Atlanta.

(Continued from page 122)

Contracts, Specifications, And Law For Engineers

This volume—by Clarence V. Dunham and Robert D. Young—includes an explanation of the basic principles of the law of contracts; a discussion of the application of these principles to construction contracts in particular, with data on the preparation of specifications; and a consideration of the various fields of law of special interest to the engineer. The authors attempt to state legal principles simply and clearly rather than quote extensively from involved court decisions or complicated legal documents. (1958, McGraw-Hill Book Company, New York 36, N. Y. 550 pp., $7.50.)

Covered Bridges Of The Northeast

A historical account of covered bridges and their builders, by Richard S. Allen. This volume describes methods and tools used in their construction, and in addition gives details for individual bridges. A special chapter is devoted to railroad bridges. Appendices provide a tabulation of existing covered bridges in New England. (1957, Stephen Greene Press, Brattleboro, Vt., 121 pp., $5.95.)

Dynamic Instability

Translated from the French by M. L. Meyer.

In this volume Y. Recard studies the general problem of dynamic instability and, in particular, self-excited oscillations arising from motion. Introductory material on simple harmonic oscillations and conservative systems is followed by a description of non-conservative systems with one or several degrees of freedom. The rest of the book concerns itself with practical problems, such as the directional instability of automobiles, the instability of suspension bridges under wind, and the flutter speeds of aircraft wings. (1957, Frederick Ungar Publishing Company, New York 10, N. Y. 227 pp., $9.50.)

Elements Of Water Supply And Waste-Water Disposal

Emphasizes the scientific principles underlying engineering applications. The first half of the book deals with the collection and distribution of water and the collection and removal of waste water, while the second half takes up the behavior of natural waters and the treatment of water and waste water. Appendices include a collection of supplementary problems and tables to simplify computations. Authors are Gordon M. Fair and John C. Geyer. (1958, John Wiley and Sons, New York 16, N. Y. 615 pp., $8.95.)

Il Costo Delle Grandi Opere D'Ingegneria

The Italian treatise—by Eugenio Campini—on the cost of large engineering works deals with a wide range of civil engineering structures. The first part is devoted to basic matters such as salaries, materials, labor, costs of transport, excavating, concreting, etc., and financing. The second part deals with works characterized by length or complexity and the third part with local works. Cost analyses are illustrated by the actual costs of important structures in Italy and in other countries. (1956, Ulrico Hoepli, Milan, Italy. 688 pp., 5,000 lira.)

Influence Lines For Continuous Beams

A series of three reports by Walter C. Boyer and Joel I. Abrams each deals respectively with two, three, and four span structures. Each report contains tables providing influence line data for continuous beams of constant moment of inertia. Influence lines for special points are developed, thus providing the data to investigate the occurrence of maximum positive moments under several conditions. Unsymmetrical cases are investigated and provide data of value in economic studies. (1958, Johns Hopkins Press, Baltimore 18, Md. Various pagings. $10.00.)

(Continued on page 126)

(Continued from page 124)

La Mecanique Des Roches

Here J. Talobre presents, for the civil engineer, a treatise on the mechanical behavior of rocks and rocky terrain comparable to the numerous works on soil mechanics. In the first two sections he deals with theoretical aspects and experimental data. The third section covers applications; drilling and excavation work; foundations; tunnel supports and linings; and other aspects of tunneling related to underground conditions; cementation and sealing. Much information is given in tabular and graphic form, and a considerable bibliography is appended. (1957, Dunod, Paris, France. 444 pp., 4800 fr.)

Papers On Soils
Special Technical Publication 206

These papers deal with testing and research projects on soils. Topics investigated include: soil explorations for site selection and engineering design; theory of soil resistance; evaluating friction and cohesion of soils; microseismics; vibration techniques used in soil compaction; field tests of piles in sand; and properties of soil cement mixtures. (The American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 178 pp., $4.50.)

The Preparation of Programs For An Electronic Digital Computer
Second Edition.

The present edition—by Maurice V. Wilkes and others—has been enlarged to offer a general introduction to programming for any computer of the stored-program type. The first part of the book gives practical examples of programming and surveys various types of order codes to be found in digital computers. In addition it discusses input and output, the contents of a library of subroutines, error diagnosis, and advanced methods. The second and third parts deal with the library of subroutines used with the Electronic Delay Storage Automatic Computer (1957, Addison-Wesley Publishing Co. Reading, Mass., 238 pp., $7.50.)

Road And Paving Materials
Special Technical Publication No. 212

This publication emphasizes bituminous paving materials. The five papers included discuss testing techniques involving the evaluation of properties and characteristics of paving asphalts, and provide a review of the effect of aggregate particles on the strength of granular materials used in bituminous mixtures. (Published 1957 by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa. 76 pp., $2.75.)

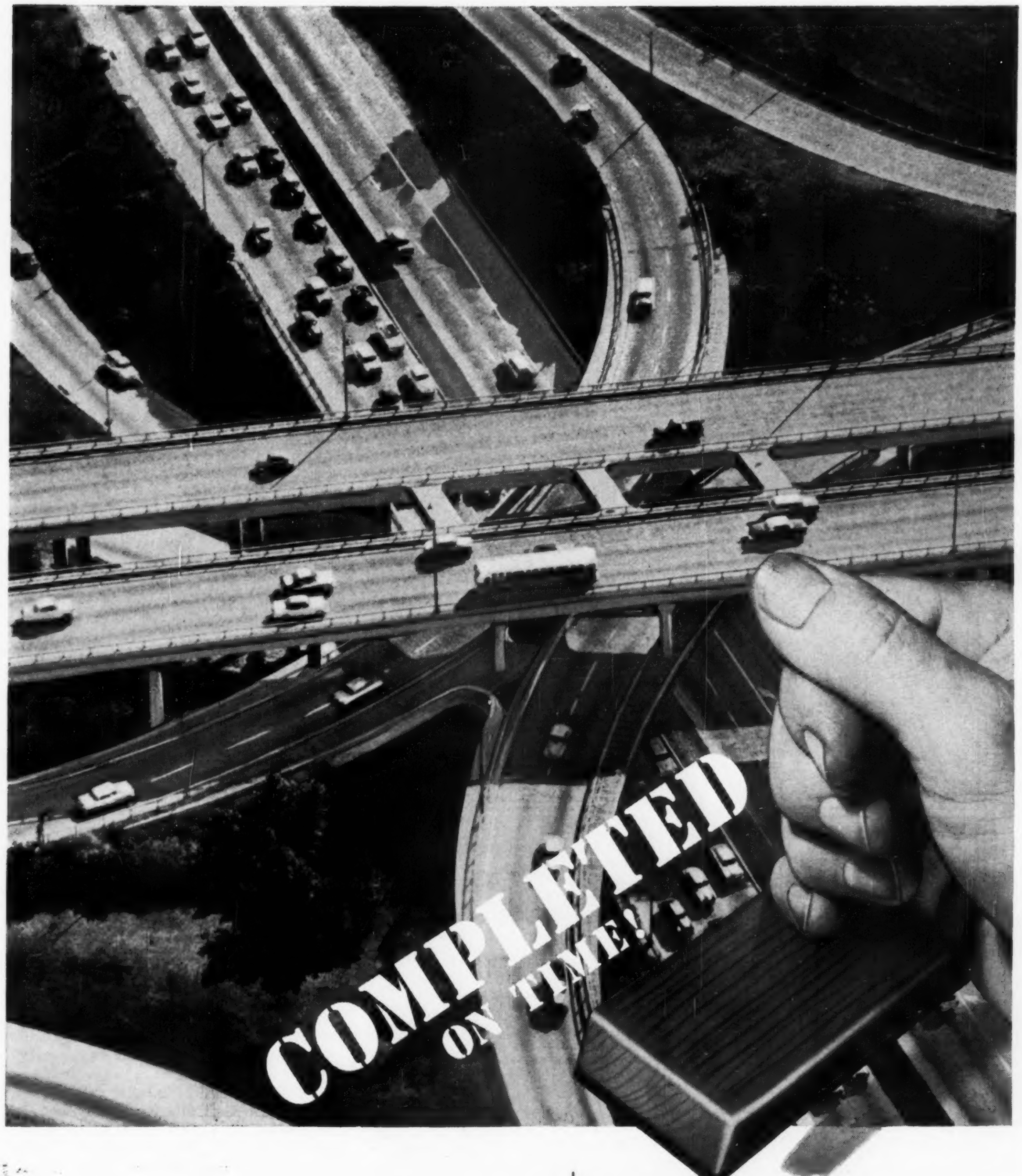
Satellites and Spaceflight

The development of the earth satellite is presented by Eric Burgess with details on construction, instrumentation, launching procedure, transmission of data, and flight orbit. This is followed by a consideration of the spaceflight program and the physiological and psychological problems connected with manned rockets and the establishment of a manned station in space. The concluding portion of the book examines the possibility of expeditions to the moon and the planets. (The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y., 1957. 159 pp., $3.95.)

The Scientific Papers of Sir Geoffrey Ingram Taylor
Volume I: Mechanics of Solids.

This volume, edited by G. K. Batchelor, is the first in a series of four, and contains all of Taylor's papers on elasticity, plasticity, the properties of metals, and dislocation theory. A number of studies prepared for government agencies are now made generally available for the first time. The three other volumes will be devoted to papers on the mechanics of fluids. (1958, Cambridge University Press, 32 East 57th Street, New York 22, N. Y. 593 pp., 7 x 10 in., bound. $14.50.)

(Continued on page 137)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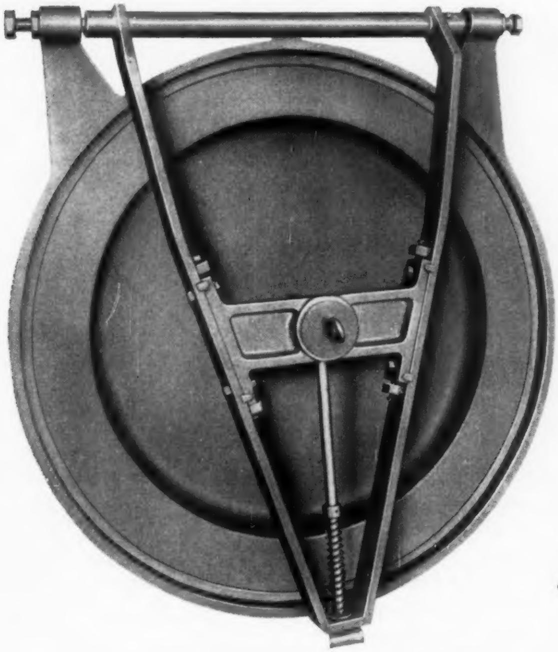
New in Education

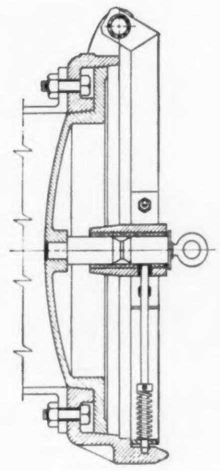
Computers in the Classroom. . . . The electronic computer has invaded the college classroom, according to Morris Asimow, professor of engineering at the *University of California* at Los Angeles. At U.C.L.A., which is thought to be the first school in the country to acquire a computer for classroom use, a Bendix G-15 is being used to help a two-year experimental program set up to train engineers for executive positions. In the Engineering Executive program, the engineer showing executive promise is acquainted with accounting, financial, personnel, labor relations, and other management problems. As far as possible, problems are solved in terms of numbers. The Bendix G-15 is a medium-sized, general-purpose unit with computing capacities and speed comparable to many of the larger machines.

Summer Studies. . . . *Manhattan College* will offer a one-week course in the Theory and Design of Biological Waste Treatment during the week of June 16. All inquiries should be addressed to W. W. Eckenfelder, Jr., Civil Engineering Department, Manhattan College, New York 71, N. Y. . . . Of special interest to civil engineers are three courses open at *Massachusetts Institute of Technology:* A two-week program on Air Pollution, August 11-22; a program on Editing Technical Reports, September 2-12 (details from Prof. Robert R. Rathbone, Department of the Humanities, MIT, Cambridge 39, Mass.); and a program on the Design and Construction of Earth Embankments, September 2-12, (details from the Office of Summer Sessions, M.I.T., Cambridge 39, Mass.). . . . *The University of California* is offering its third annual summer program in "Nuclear Energy for Industry." An intensive nine-week "Nuclear Engineering Short Course" begins June 16. In the week beginning July 7, there will be a non-technical "Nuclear Engineering Survey" for the benefit of executives and administrators. Further information is available from Engineering and Sciences Extension, Room 100, Building T-11, University of California, Berkeley, Calif. . . . *The California Institute of Technology* is offering a summer conference on Supervision of Engineers, June 22-27. This conference will be repeated September 14-19. Inquiries should be directed to Milton Gordon, associate director, Management Development Center, California Institute of Technology, Pasadena, Calif. . . . *Pennsylvania State University* will conduct its fourth annual Technical Report Writing Seminar, September 14-26, at University Park. Information may be obtained from the Extension Conference Center, Pennsylvania State University, University Park, Pa.

(Continued on page 130)

ARMCO HYDRAULIC CUSHION FLAP GATE
Eliminates slamming on pump discharge lines





Cut-away drawing of Armco Hydraulic Cushion Flap Gate

This type of gate, manufactured exclusively by Armco, is made of cast steel with stainless steel and bronze fittings to insure free operation at all times.

You can use the Armco Hydraulic Cushion Flap Gate on the end of pump discharge lines to prevent the violent slamming that is common with standard flap gates. This gate closes gently—with no shock or vibration.

It has two distinct movements. One is about the hinges as with all standard flap gates. The other is parallel with the axis of the pipe. During this last movement, water entrapped around the circumference of the gate seat acts as a cushion and is slowly released to allow the flap to seat gently.

The Armco Hydraulic Cushion Flap Gate is just one example of the wide variety of Armco Gates for water control. There are more than 600 different sizes and models of standard Armco Gates to control heads up to 100 feet of water. Sizes range from 6- to 108-inch round or square openings.

For more information on Armco Water Control Gates, just fill out and mail the coupon below. Armco Drainage & Metal Products, Inc., 4988 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

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ARMCO GATES

ARMCO ®

New in Education

(Continued from page 128)

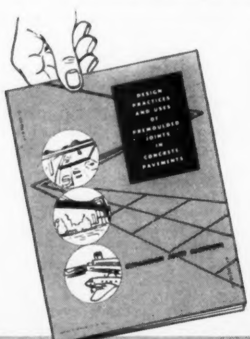
For Graduate Students. . . . Increased financial assistance to ambitious engineering students is being made available through a number of new scholarships. The Raymond Concrete Pile Company has established a full fellowship in memory of the late A. E. Cummings, M.ASCE, long-time director of research and a director of the company. The scholarships will finance the studies of a graduate student in soil mechanics at the *University of Illinois*. . . . Minimum stipends of $1,500 are available at *Rice Institute* for graduate assistants in sanitary engineering, working towards a M.S. Further information is available from A. W. Busch, Assistant Professor, Civil Engineering, Rice Institute, Houston 1, Tex. . . . *The National Science Foundation* announces the award of 756 predoctoral graduate fellowships in the natural sciences and allied fields. There were 85 winners of regular postdoctoral fellowships from the Foundation. These awards were made in furtherance of the Foundation's policy of encouraging gifted college graduates to obtain advanced training in science on a full-time basis. Application forms for the 1959-1960 awards will be available upon announcement of the programs in October 1958. The Foundation will also provide a limited number of travel grants to help scientists attend conferences and congresses. Application deadlines are June 30 and December 31 for travel following those dates. Information is available from Associate Director for Mathematical, Physical and Engineering Sciences, National Science Foundation, Washington 25, D. C.

Generous Grants. . . . There is no evidence of the recession in academic grants awarded this spring. The Atomic Energy Commission has awarded a grant of $8,061 to the *University of North Carolina* to equip a radiation laboratory in the Department of Sanitary Engineering in the School of Public Health. For information on graduate study, assistantships, and fellowships, write to the Department of Sanitary Engineering, P. O. Box 899, Chapel Hill, N. C. . . . Three unrestricted grants have been bestowed upon *Lehigh University*. Donors are the Lehigh Portland Cement Company with $1,900; the First National City Bank of New York with $1,650; and the Budd Company's aid-to-education program with $693. These gifts will be used to improve several undergraduate laboratories. . . . The Creole Foundation of Venezuela has contributed $30,000 to *Massachusetts Institute of Technology* for MIT's program of research and education in soil engineering. . . . With a grant of $106,000 from the Carnegie Corporation, *Case Institute of Technology* will establish a one-year program of study and action aimed at major improvements in engineering education.

(Continued on page 132)

. . . modern, properly jointed highways provide greater value for dollars spent!

NEW "DESIGN PRACTICES" MANUAL AVAILABLE FREE OF CHARGE!



The first of its type ever produced . . . prepared by the major manufacturers of premoulded joint materials. You'll find the comprehensive technical data, premoulded joint applications and installation information, a valuable addition to your pavement design file. Send coupon today for your copy.

Highway planning and design level thinking should not only be based on the initial cost of new highways, but on the over-all lifetime costs. In fact, we should be sure we are not being "penny wise" and "pound foolish" by looking only at initial costs, but let's build highways that will provide a greater and more economical service lifetime. Plan now, at the design level, to reduce these massive yearly maintenance costs by designing modern, properly jointed highways that will provide maximum service with a minimum maintenance expense. Remember, every saving realized through reduced maintenance, will provide added miles of highways for the same expenditure of public funds.

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New In Education

(Continued from page 130)

Plans and Projects. . . . *The University of Detroit* has organized a special "Task Force" to operate in the field of engineering education. Five areas will be covered by the new plan: Assistance in orienting high school students for education beyond high school; exploration of expansion of the use of television for business and industry; exploration of the university's present Cooperative (Work-Study) Plan of Education; exploration of expansion of Cooperative Institutions now in effect at the university; and a variety of assignments concerning all phases of education. . . . Research work at *Northwestern University* will begin this spring on a 100-ft "model" bridge. The steel structure is a half-sized replica of a 200-ft railroad bridge, will be one of the most powerful test structures in the country. When completed, it will have a hydraulic loading system of fourteen 150-ton jacks capable of exerting a total force of 4,200,000 lb. . . . A giant 120-ft atom smasher has gone into operation in the physics department of *Yale University*. The $1,800,000 atom smasher was financed by the Atomic Energy Commission. . . .

New Publications

Engineering aptitude . . . "Do I have engineering aptitude?" is the question many young men (and women, too, we hope) are asking themselves these days. A set of questions, answers, and interpretation of answers for help in making this all-important decision comprises a brochure by Dr. A. Pemberton Johnson, assistant director for the Newark College of Engineering Counseling Center. Single copies are available to high school principals, counselors, editors, and engineers writing on their own letterhead and enclosing a self-addressed stamped envelope. Such requests should be sent to the New Jersey Engineers' Committee for Student Guidance, Newark College of Engineering, 367 High Street, Newark, N. J. Bulk orders should be sent to Engineers' Council for Professional Development, 29 West 39th Street, New York 18, N. Y. The cost is $2 per package of 50.

Atomic energy. . . . Three years of progress in the peaceful uses of atomic energy are summarized in the Twenty-third Semiannual Report of the Atomic Energy Commission. Subjects included in the 462-page volume are radioisotopes; power reactors; growth of the industry; progress in international cooperation; and physical research. According to the report, more than 1,000,000 copies of its technical publications, both classified and unclassified, have been sold since 1954. The report is published by the U.S. Government Printing Office, Washington 25, D. C.

Engineering economics. . . . A new quarterly in the field of engineering economics is being sponsored by the Engineering Economy Division of the American Society for Engineering Education. Emphasis will be on latest developments in equipment acquisition and replacement analysis, capital budgeting, economic evaluation, and a host of other related subjects in the field of engineering economics. The subscription rate is $3.00 a year. Checks should be made payable to "The Engineering Economist" and sent to the editor, Prof. Arthur Lesser, Jr., Head, Department of Industrial Engineering, Stevens Institute of Technology, Hoboken, N. J.

Stainless steel curtain walls. . . . Results of a recent research study on stainless steel curtain walls, conducted by Princeton University's School of Architecture, have just been released. The study is part of a research project commissioned by the Committee of Stainless Steel Producers of the American Iron and Steel Institute and supplements a recent series. A comprehensive chart tabulates technical specifications for all buildings using any significant amount of stainless steel. Photographs and architectural drawings illustrate curtain wall panel details, methods of attachment, insulation, and weatherseal systems for a number of notable structures. Inquiries should be addressed to the Stainless Steel News Bureau, 60 East 42nd Street, New York 17, N. Y.

Nuclear Congress papers . . . This is the last call for 1958 Nuclear Congress Preprints and Proceedings. (See page 82 for an account of the Congress.) Publication of the transactions of the conference in one volume is not planned. The proceedings of the Hot Laboratories and Equipment Conference are $10 per bound volume. The preprints sell for 50 cents apiece. Checks should be made out to the American Institute of Chemical Engineers and sent to Joel Henry, Congress Manager, 25 West 45th Street, New York 36, N. Y. The complete list of preprints is available from Mr. Henry.

Contract method of construction. . . . Issuance of an eighth reprint of its popular booklet, "The Contract Method of Construction Safeguards Public Funds," is announced by the Associated General Contractors (Munsey Building, Washington 4, D. C.). First published in 1948, the booklet has been widely used in university construction courses in leading engineering schools.

(Continued on page 133)

(Continued from page 132)

Nuclear energy. . . . A new source of detailed information on all major reactor plants in the United States and abroad will be available in a series of publications planned by the American Society of Mechanical Engineers. The first volume in the series—available this spring and entitled "Power Reactors— will cover design and construction details for sixteen units for power generation. The reference, priced at $3.00, is available from the Order Department of ASME, 29 West 39th Street, New York 18, N. Y.

Strength of metals . . . Two valuable new publications have been issued by the American Society for Testing Materials. "1956 References on Fatigue" is a listing of about 370 references to articles published in 1956 dealing with fatigue of structures and materials. An abstract of most references is included in the 68-page booklet. "Compilation of Chemical Compositions and Rupture Strengths of Super-Strength Alloys" gives the name, nominal chemical composition, characteristic rupture strength and patentee for about 225 domestic and foreign alloys. The bulletins may be obtained from the Society, 1916 Race Street, Philadelphia 3, Pa., for $3.00 and 75 cents respectively.

Bituminous materials . . . Specifications, test methods, recommended practices, and definitions of terms pertaining to "Bituminous Materials for Highway Construction, Waterproofing, and Roofing" are compiled in a bulletin just released by the American Society for Testing Materials. The sixth edition of the 460-page compilation may be purchased from ASTM Headquarters, 1916 Race Street, Philadelphia 3, Pa., at $4.75 per copy.

Nailing of subfloors . . . The results of comparative tests performed on various sorts of nails are reviewed in a new bulletin written by E. George Stern, M. ASCE, research professor of wood construction at Virginia Polytechnic Institute. For information write Professor Stern at V.I.P., Blacksburg, Va.

Fir plywood . . . "Basic Facts about Fir Plywood Diaphragms," a new booklet of the Douglas Fir Plywood Association, proposes to answer questions on this relatively new design method. The 10-page illustrated brochure presents the results of several years of research and testing by the research and engineering staff of DFPA, the U. S. Forest Products Laboratory, and the Oregon Forest Products Laboratory. Single copies are available upon request from DFPA, Tacoma 2, Wash.

Research reactors . . . With research reactors finding increasing application in advanced education in nuclear science and engineering, and in nuclear research, two new Atomic Energy Commission bulletins are particularly timely and valuable. "U. S. Research Reactors" provides a compact summary of technical information on major types of research reactors developed in the United States. It is available from the Office of Technical Services, U. S. Department of Commerce, Wash. 25, D. C., at $1.50 per copy. Also available is a publication containing papers presented at the AEC's recent Engineering Test Reactor Industrial Preview at Idaho Falls (November issue, page 100). For information write the AEC Idaho Operations Office, Idaho Falls, Idaho.

(Continued on page 135)

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC.

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This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient non-profit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

PROJECT MANAGER, M. ASCE, B.S. in C.E., 49, resident engineer domestic and overseas from 1931 to 1945; project manager, construction, domestic and foreign from 1945 to 1955; engineering consultant and project manager from 1955 to 1958. Location desired, East, South or foreign. C-329.

CIVIL ENGINEER, J.M. ASCE, B.S.C.E., 27, recent graduate desires position as junior engineer with municipality or consultant firm. One year experience with steel fabricating firm specializing in construction products. Has been working with steel joist, doors sash, roof deck and reinforcing steel for buildings and bridges. Experienced in detailing for shop fabrication and erection. Location desired, Northeastern United States. C-330.

ADMINISTRATIVE ENGINEER, A.M. ASCE, business administration with B.S. C.E., 45, 3 years' chief of construction management division, 3½ years' cost coordinator and contract coordinator, 9 years' general purchasing agent or buyer for all construction on materials and equipment, 1½ years' cost clerk, 4 years' field engineer. Real estate salesman license—Michigan—certificate in real estate from University of Michigan. Location desired, Midwest. C-331-9601-Detroit.

ASSISTANT ENGINEER, J.M. ASCE, B.S.C.E., 28, experienced in refinery pressure vessel design, reinforced concrete foundation design, and some steel design. Location desired: New York City. C-332.

ENGINEERING EXECUTIVE, M. ASCE, 54, licensed P.E. in New York, Pennsylvania, Indiana; NBER certificate. Chemical, civil and heavy industrial experience. Administration and supervision of design; proposals, contracts, reports, client contact. Location desired, U.S. or Canada. C-333.

CONSTRUCTION SUPERINTENDENT, A.M. ASCE, B.S. in C.E., 47, 25 years' experience in supervision of diversified heavy construction, including docks, bridges, buildings, drydocks. Desires responsible position with future. Location desired, West Coast but not essential. C-334-1184-San Francisco.

CIVIL ENGINEER, J.M. ASCE, M.S. in C.E., 26, single, 5 years' experience—3 years' in bridge construction, field work, and structural design, 1 year research in military engineering in Hungary, 1 year subdivision design in California. Grading, storm drains, sewers, estimating. Speak several languages. Desire steady job in San Francisco Bay area. C-335-San Francisco.

CIVIL ENGINEER, A.M. ASCE, 33, Master's degree and registered professional engineer. 7 years' teaching, principally structures. Varied field experience. Currently associate professor. Seeking challenging position in field, office, or education. C-336.

EDUCATION ADMINISTRATOR, M. ASCE, B.S.-M.S.C.E., 52. 26 years' teaching-research experience, including 3½ years' in charge of federal testing laboratory and 9 years' chairman of C.E. and director of research. Registered P.E. Two textbooks in process. Available, June, 1958. Location desired, West or Midwest preferred. C-337-878-Chicago.

CIVIL ENGINEER (soils and water), 34; supervisory experience aluminum smelter construction, earthwork, soil mechanics, drainage, water control, water supply, sewerage, sewage and waste disposal projects and office administration. Location desired, California, S.W. Foreign. C-1037-San Francisco.

Positions Available

ENGINEERS, (a) Sanitary Engineer experienced in the design of sewage treatment works; would also be required to work on water treatment plants and other projects in the water and sewerage fields. Salary open. Location, upstate New York. (b) Engineer's Assistant for the layout and inspection of sewer construction. Salary open. Location, vicinity of Poughkeepsie, N.Y. W-4747.

TEACHING PERSONNEL, Instructors to Associate Professor, graduate mechanical or civil, to teach heat and power and industrial engineering; electrical-electronic courses and civil sanitary, hydraulics or structural engineering. Rank will be determined by qualifications. Appointment for September 1958. Salaries, $4,500-$6,000 for nine months. Location, Ohio. W-5711.

ARCHITECT OR ARCHITECTURAL ENGINEER, experienced in estimating, design and project managing for a general contractor. Newly opened position. Salary commensurate with experience and ability. Company pays placement fee. Location, Western Canada. W-5804.

CONSTRUCTION SALES MANAGER, to 33, graduate engineer, preferably from M.I.T. or similar school, with outstanding sales and management ability. Excellent opportunity with well-established building contractor. Location, New York, N. Y. W-5833.

SANITARY ENGINEER, B.S. in sanitary engineering, and a master of public health degree from an accredited school of public health, and at least five years' experience in public health at the municipal, county, state, or national level. Will plan and direct, also supervise public health programs. Knowledge of Spanish. Salary, $12,000 a year tax free. Some travel. Headquarters, Washington, D.C. W-5845.

ENGINEER, graduate civil and structural, experienced. Will design complex steel structures, reinforced and prestressed concrete. Permanent. Company will pay moving expenses. Salary open. Location, Midwest. W-5872.

CIVIL ENGINEERING, young, with actual experience in highway engineering. Career connection with national organization having continued

(Continued on page 136)

(Continued from page 133)

Wood research . . . Four new bulletins have been added to the list of publications offered by the Wood Research Laboratory of Purdue University: "Nail-Glued Roof Trusses from Low-Grade Hardwood Lumber," by Donald H. Percival; "How to Select Hardwood Lumber for Structural Nail Gluing," by Stanley K. Suddarth; "How to Nail-Glue Hardwoods and Softwoods," by Hugh D. Angleton; and "How to Build a 40-Foot Clear-Span Trussed-Frame," by W. H. Friday, A. C. Dale, R. H. Perkins, and S. K. Suddarth, are currently available. For information write the Wood Research Laboratory, Agricultural Experiment Station, Purdue University, Lafayette, Ind.

Pollution control, bibliography . . . A valuable new "Handbook of Selected Biological References on Water Pollution Control, Sewage Treatment, and Water Treatment" is now available. The U. S. Department of Health, Education, and Welfare is the publisher of this revised 1957 edition, written by William M. Ingram and identified as Public Health Service Publication No. 214. Copies may be purchased from the Superintendent of Documents, U. S. Government Printing Office, Wash. 25, D. C., at 45 cents per copy.

Toll highways . . . Work on the Northern Illinois Toll Highway is reviewed in the Seventh Quarterly Progress Report published by the state Toll Highway Commission. Profusely illustrated, the bulletin deals with construction status, tollway facilities, finance, and economies during the construction stage. Inquiries may be addressed to the Illinois State Toll Highway Commission, 20 North Wacker Drive, Chicago 6, Ill.

Arc welding . . . The second edition of "New Lessons in Arc Welding" is now available from the publisher, the Lincoln Electric Company of Cleveland, Ohio. Based on arc welding courses taught at the Lincoln Arc Welding School, the work is a practical text and excellent rference. Copies may be obtained from the publisher at $1.00 each postpaid in the U. S. A., and $1.50 elsewhere.

Non—ASCE Meetings

Air Pollution Control Association. Annual meeting at the Sheraton Hotel, Philadelphia, Pa., May 25-29. For information write Milton Reizenstein, president of the Association, 4400 Fifth Ave., Pittsburgh 13, Pa.

American Society of Heating and Air-Conditioning Engineers. All-Industry Conference on Control, ASHAE Research Laboratory, Cleveland, Ohio, May 14. For information write to H. W. Alyea, c/o ASHAE, Milwaukee, Wisc.

(Continued on page 138)

(Continued from page 134)

interest in highway engineering, research and construction. Give full details in first letter. Location, East. W-5894.

Hydraulic Designer with experience in the hydraulic design of centrifugal pumps; age about 30; will be responsible for complete hydraulic design of centrifugal pumps and would act in advisory capacity to chief engineer. Salary to start, $8,000 a year. Location, vicinity of Syracuse, N. Y. W-5896.

Engineer-Writer, graduate civil engineer, 35-45, with several years' work in design and construction in structural steel, either with a consulting engineering office or with a structural steel fabricator; some experience in writing technical reports and preparing text for advertising or promotional bulletins. Will handle correspondence, etc., for consulting engineers seeking technical information or assistance on special engineering problems; furnish technical advice and guidance on selecting and digesting articles; do creative writing for promotional booklets and technical data sheets, etc. Salary open; insurance and retirement plans available. Location, New York, N. Y. W-5897.

Teaching Personnel for Department of Civil Engineering. (*a*) Instructors, to teach surveying, engineering mechanics, strength of materials and fluid mechanics. Master's degree preferred but not absolutely required. (*b*) Assistant or Associate Professor to teach soil mechanics, foundations and structures. Master's degree with special training or experience in soil mechanics required. Salaries: (*a*) $5,000; (*b*) $6,000-$7,000 for academic year. Position available September 1, 1958. Location, upstate New York. W-5898.

Construction Managers, with project, office, cost, estimating, scheduling and liaison experience, covering institutional and commercial building construction. (*a*) Project Manager, 40-50, with civil engineering training and at least 10 years' experience as above. Salary, $10,000 a year. (*b*) Assistant Project Manager, 30-40, with civil engineering training and at least five years' experience as above. Salary, $8,000 a year. Location, New York area. W-5906.

Project Design Engineer, graduate civil, with extensive experience in structural steel and reinforced concrete design for industrial building. Salary, $10,000-$12,000 a year. Location, New York, N. Y. W-5911.

Supervisory Construction Personnel, preferably graduate engineers, with primary experience in hydroelectric construction. Company has long range hydro and thermal construction program. Submit complete résumé, salary requirements and references. Location, South. W-5957.

Instructor, civil, to handle statics, dynamics, strength of materials. Salary open. Location, Pennsylvania. W-5958.

Instructor, Assistant Professor or Associate Professor, M.S. in civil engineering preferred, with some industrial experience, to teach courses in statics, dynamics, strength of materials, hydraulics and surveying. Opportunity to work into teaching more specialized civil engineering subjects in ECPD accredited curriculum. Salary, ranging from $4,200-$6,000 for 9 months, depending upon rank. Location, Southwest. W-5964.

Sanitary Designer with 3 to 5 years' experience in sewerage treatment plants and water supply systems, layout, design and surveys. Salary, $6,500-$7,200 a year. Location, Connecticut. W-5975.

Plant Design Engineer, mechanical or civil graduate, with at least 5 years' stress analysis experience on power and process equipment, to supervise design and analysis of equipment, structures, piping and foundations. Salary, $9,000 a year. Location, Connecticut. W-5979.

Director of Engineering to correlate, program, and direct the engineering design service to provide sound engineering design at reasonable cost for large engineering architectural consulting organization. Should be a licensed professional engineer, preferably but not necessarily structural. Heavy administrative as well as technical experience working with architects on major commercial and industrial buildings. Salary,

(Continued on page 137)

(Continued from page 136)

$14,000-$18,000 a year, plus profit-sharing plan and top fringe benefit program. Location, California. W-5984.

CONSTRUCTION MANAGER, civil graduate, with at least 10 years' supervisory heavy construction experience including considerable earthmoving work. Must speak Spanish. Salary, $18,000 a year, plus bonus. Location, Venezuela. F-6012.

PLANT ENGINEER, mechanical or civil engineering degree, 26-35, with 3 to 8 years' preferably in materials handling and equipment layout work, for designing and drawing of equipment and small steel structures in food-processing plant. Salary, $8,000 a year. Location, Maryland. W-6029.

TEACHING PERSONNEL. (a) Civil Engineers; (b) Engineering Mechanics; (c) Assistant and Associate Professors and (d) Instructors. M.S. degree desirable, instructors working toward advanced degree considered. Applications for position as Instructor in Engineering Drawing, Descriptive Geometry, and Surveying will also be considered. Positions available September 1958. Location, West. W-6030.

FIELD AND OFFICE ENGINEER, civil engineer or civil planning, to 40, with 5 or more years' in city and urban planning—streets, expressways, etc. Duties as field promotional engineer, contacting cities and municipalities promoting use of concrete on streets, expressways, roads, etc., some travel for a trade association. Salary, to $10,000 a year. Employer will pay placement fee. Location, Chicago. C-6649.

SALES ENGINEERS—CIVIL-SANITARY, recent graduates or experienced. Duties will include sales for manufacturers of municipal, water, sewerage and waste treatment equipment serving entire U.S. Experience preferred. Salary recent graduates; $5,400; Exprienced, $7,200 plus commission. Employer will negotiate placement fee. Locations: Midwest, Pacific Coast and South East. C-6797.

ENGINEERS, (a) Highway Engineer, graduate civil engineer, 30-40, with 5 or more years' experience in planning, administration, and economics of highways. Should have previous experience with a state highway department or bureau of public roads. Will work with highway and federal agencies. (b) Design and Construction Engineer on air field pavements. Experience with Air Force, Navy or government agency. Will contact government agencies, engineers, cities, counties and other airport agencies, travel for a trade association. Employer will pay placement fee. Salary, to $10,000 depending on experience. Headquarters, Chicago. C-6798.

HYDRO ENGINEERS—DAMS, civil engineer, with hydroelectric power dam experience for project work—hydroelectric engineer on design and general engineering problems related to dam construction. (Maybe interested in electrical or mechanical engineering experienced in above fields.) Salary, $8,400-$10,200 a year. Location, San Francisco. S-3478.

Positions Announced

Sacramento District, Corps of Engineers. Vacancies for civil engineer (estimates) GS-9 or GS-11; civil engineer (specifications) GS-9 or GS-11. Send applications to D. C. Williams, chief of Personnel Branch, U.S. Army Engineer District, Sacramento, P.O. Box 1739, Sacramento, Calif., by air mail.

U. S. Navy. Engineer wanted on Guam, materials testing and evaluation, GS-12. Apply to Navy Overseas Employment Office, (Pacific) Section A, 45 Hyde St., San Francisco, Calif. Civil Engineer, GS-9-11, wanted at the Mare Island Naval Shipyard, Vallejo, Calif. Send Form 57 to Employment Superintendent, Code 172, Vallejo, Calif.

RECENT BOOKS

(Continued from page 126)

Scientific Societies In The United States

Second Edition.

An historical account by Ralph S. Bates of the development of scientific and technological societies in America from their beginnings in the eighteenth century to the present. This edition includes a new chapter on the activities of societies since the second World War. The extensive bibliography has been completely revised and contains further sources of information for most of the major and many of the smaller societies. (1958, Columbia University Press, 2960 Broadway, New York 27, N. Y. 297 pp., $6.50.)

Symposium On Vane Shear Testing Of Soils

Special Technical Publication No. 193

These papers deal with a comparatively recent development in the testing of soils. An introductory paper on the apparatus and method of vane shear testing is followed by three specific applications: deep vane tests in the Gulf of Mexico; a vane in-place soil shear measuring device developed and applied in Oregon; and the use of a field vane apparatus in sensitive clay. (American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1957. 70 pp., $9.50.)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and translations services, and can supply photoprint or microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N.Y.

NON-ASCE MEETINGS

(Continued from page 135)

American Society of Mechanical Engineers. Conference on Materials Handling, National Materials Handling Exposition, Public Auditorium, Cleveland, Ohio, June 9-12. To register write Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

American Society for Metals. First Southwestern Metal Exposition and Congress at the Statler-Hilton Hotel and Texas Hall of State, Dallas, Tex., May 12-16.

American Society of Planning Officials. National Planning Conference, Hotel Statler, Washington, D. C., May 18-22.

American Society for Testing Materials. Annual meeting at the Hotels Statler and Sheraton-Plaza, Boston, Mass., June 22-27. Information from the ASTM, 1916 Race St., Philadelphia 3, Pa.

Atomic Energy Commission. Fifth International Electronic and Nuclear Energy Exposition in Rome, Italy, June 16-30. Details from John Vinciguerra, Assistant Manager, AEC Savannah River Operations Office, Aiken, S. C.

Inter-American Association of Sanitary Engineering. Sixth Inter-American Congress of Sanitary Engineering, Lima, Peru, May 19-24.

National Society of Professional Engineers. Annual meeting, Chase—Park Plaza Hotels, St. Louis, Mo., June 11-14.

Royal Society of Flemish Engineers. Third International Congress of Port Techniques, June 15-21 in Antwerp, Belgium. Inquiries to the Society, Torengebouw VIII, 31 Schoenmarkt, Antwerp, Belgium.

Society for Experimental Stress Analysis. Annual spring meeting, May 14-16 at the Hotel Manger in Cleveland, Ohio. Information from Dr. W. W. Murray, P. O. Box 168, Cambridge 39, Mass.

Society of Naval Architects and Marine Engineers. Spring meeting at Hotel Chamberlin, Old Point Comfort, Fort Monroe, Va., June 2-3.

Applications for Admission to ASCE, March 3-March 29

Applying For Member

VERITA ALLEN BATES, Montgomery, Ala.
LULTCHO BODUROFF, Denver, Colo.
KENNETH NORTON BRADLEY, Tulsa, Okla.
WILLIS VINTON BRAME, Chicago, Ill.
JOHN PAGE BUEHLER, San Francisco, Calif.
JOHN BUCKSON CARSON, Baltimore, Md.
HOMER LEON CHASTAIN, Decatur, Ill.
KENNETH KUAN-NING CHEN, New York, N. Y.
FREDERICK GORDON COFFIN, Dhahran, Saudi Arabia.
JOSEPH HARVEY COMER, JR., Menlo Park, Calif.
FRANCISCO JAVIER CORDOVA, Michigan City, Ind.
CHARLES CURIONE, Lt., Washington, D. C.
JAMES JOSEPH DANAHER, JR., Mobile, Ala.
WILLIAM CLEMENT ELLEDGE, Rolla, Mo.
MORTON SAMUEL FINE, Hartford, Conn.
ISRAEL GOLDBERG, Boston, Mass.
RONALD ARTHUR GORDON, Wilmington, Ohio.
JOHN ALBERT HAWTHORNE, Nassau, Bahamas.
GEORGE MARLEY HITE, Chicago, Ill.
LELAND BERNAL JONES, Walla Walla, Wash.
HOWARD KENNETH JUSTICE, Cincinnati, Ohio.
ANTONY KOSTEAS, Athens, Greece.
FRANK ALLISON LINVILLE, Tuscon, Ariz.
JOHN WILLIAM MANNING, Kansas City, Mo.
JESSE ROLAND MATHIAS, Topeka, Kans.
CHARLES JOHN MERDINGER, Port Hueneme, Calif.
CLARENCE JOSEPH MONTGOMERY, JR., Houston, Tex.
THOMAS ATTILIO MONTI, Montreal, Que., Canada.
WILLIAM JOHN MOORE, Cleveland, Ohio.
THURMAN CLYDE MORGAN, Baton Rouge, La.
SAYYID GHULAM MURTAZA, Karachi, Pakistan.
JAMES PATRICK O'DONNELL, New York, N. Y.
RUSSELL RICHARD PHELPS, Beaumont, Tex.
ROBERT MORTON PRICE, Philadelphia 5, Pa.
WILLIAM JAMES QUINN, McCook, Nebr.
LOWELL SANFORD RAU, San Diego, Calif.
HERVEY OMER REED, Topeka, Kans.
TEDDY VANCE ROUSE, Webster Groves, Mo.
FREDERICK L. RYDER, Farmingdale, N. Y.
EDWIN HENRY SCHMIDT, Tulsa, Okla.
EUGENE H. SCOFIELD, Columbus, Ohio.
WILLIAM ROBERT SEMPLE, Los Angeles, Calif.
WILLIAM KENT SHAFFER, Wilmington, N. C.
HOWARD WILLARD SLACK, Jackson, Mich.
EDWARD JOHN SLEZAK, Garden City, N. Y.
LEO ALLAN STELLY, Detroit, Mich.
W. HAROLD STUART, Portland, Ore.

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Wilho Nestor Suominen, Lincoln University, Pa.
Donald Clarence Sutherland, Denver, Colo.
Donald Louis Todd, Roanoke, Va.
George Stewart Todd, Belfast, Ireland.
Ross McRae Webb, Port Hueneme, Calif.
Tom Polk Williams, Jr., Santa Cruz, Calif.
Edwin Francis Wright, Baltimore, Md.
Glen Alvin Yake, Spokane, Wash.

Applying For Associate Member

James Clinton Akerley, Boston, Mass.
Munir Nouri Allahwerdi, Harrisburg, Pa.
Socrates Angelides, Athens, Greece.
Luis Alberto Arevalo, Glendale, Calif.
Rodrigo Alberto Arosemena, Los Angeles, Calif.
Krishna Chandra Asthana, Assam, India.
Harry Frederick Aumack, Jr., San Jose, Calif.
Robert Jay Becker, Indianapolis, Ind.
Henry Gooch Beckham, Jr., Lancaster, S. C.
Harold Wayne Beemer, Shawnee, Kans.
Paulus Minne Boersma, Montreal, P. Quebec, Canada.
Charles Boulva, Montreal, Quebec, Canada.
Johannes Gerhardus Breitenbach, Cape Province, S. A.
John West Brown, Detroit, Mich.
Levi Aloysius Brown, Detroit, Mich.
Joseph Francis Xavier Burke, Trenton, N. J.
Albert Victor Burns, Jr., Callao, Peru.
Albert R. Calderone, Grand Island, N. Y.
Richard Alfred Carr, New York, N. Y.
Edward Wentworth Cochran, Newport News, Va.
Eugene Francis Cook, San Diego, Calif.
John David Daigh, Capt., Arlington, Va.
Carl Louis Day, Jr., Pittsburgh, Pa.
Mohammad Munawar Desmukh, Elgin, Ill.
Gordan Wayne Dykes, Tullahoma, Tenn.
Robert Gordon Eiland, Sacramento, Calif.
John William Ferguson, New York, N. Y.
Stewart Herrick Fonda, Jr., Chicago, Ill.
Walter Joseph Francl, Ontario, Canada.
Julius Glazer, Garden City, L. I.
Billy Mack Gray, Nashville, Tenn.
Fred Charles Guenther, Jr., Sacramento, Calif.
Phil Creager Haggman, Denver, Colo.
Robert James Hallawell, Canton, Ohio.
Ib Stouman Hansen, Washington, D. C.
William Sylvester Higgins, Atlanta, Ga.
Frank Wayne Hill, Oakland, Calif.
Augustine Iglesias, Jr., New York, N. Y.
Frank Revelon Ireland, Dallas, Tex.
Nelson Mijares Isada, Syracuse, N. Y.
Leif William Iverson, Ft. Harrison, Mont.
Robert Bumsted Jarvis, New York, N. Y.
Warren Hipple Johnson, Deerfield, Ill.
Hymen Jonas, Milwaukee, Wis.
Isiah William Katcher, New York, N. Y.
Jack Kraning, Denver, Colo.
Shuan-Hsien Kwoh, Chicago, Ill.
Manthey Bjerknes Larsen, Chicago, Ill.
Yat-Sun Lau, Middlesex, England.
Robert Hugh Lauer, Boston, Mass.
Lawrence Lawton, Jamaica, N. Y.
Claude Lee LeFevere, Jr., Johnson City, Tenn.
Morris Levy, Union, N. J.
Elbert Leo Lewis, Elizabeth, Ky.
Janusz Jozef Lewkowicz, Accra, Ghana.
Julian Liu, Jamaica, N. Y.
Alwin A. Lopyan, Bayside, L. I.
Pinnapakkam Subba Mani Sundaram, Halifax, N. S., Canada.
Howard Leslie Millard, Dedham, Mass.
Robert Earl Morris, Tulsa, Okla.
James Ernest Mortensen, Havana, Cuba.
John Edward Moser, Milwaukee, Wis.
Hans Nuetzel, Los Angeles, Calif.
Shamsher Singh Panjoo, Panjab, India.
Michael Praszker, Mill Valley, Calif.
John William Quillinan, Chicago, Ill.
Archie Merrill Richardson, Jr., Cambridge, Mass.
Henry Theodore Roehl, Baltimore, Md.
John Phillip Ruhmann, Wichita Falls, Tex.
Ronald Alvin Rystrom, Topeka, Kans.
Roy Bond Sawhill Seattle, Wash.
Joseph Elmer Scott, Kingsport, Tenn.
Christopher Alexander Somogy, Akron, Ohio.
Marvin David Tetrick, Bishop, Calif.
Frederick Lloyd Thompson, Sr., Concord, N. H.
Winfield Scott Tilton, Jr., Juneau, Alaska.
Ralph Pleasant Triplett, Ashtabula, Ohio.
Louis David Troglia, Chicago, Ill.
Christoffel Nicolaas Lombaard Van Huyssteen, Transvaal, South Africa.
Fernando Venancio Filho, Sao Paulo, Brazil.
Demetrios George Vingileos, Brookline, Mass.
Panangipalli Viswanath, Eluru, India.
Lowell Kahler Weaver, Jr., Wilmington, Del.
Roland Wilbur Weidner, Baltimore, Md.
Robert Heinrich Weiss, Zurich, Switzerland.
Thomas Gerard Whipple, New Orleans, La.
Glen Price Willard, Sewickley, Pa.
Harold Walter Wilson, Indianapolis, Ind.
Roman Wolchuk, New York, N. Y.
Thomas Haden Wright, Rapid City, S. D.
Chan-Wah Yu, Chicago, Ill.
Herman Peter Zanoni, Milwaukee, Wis.

Applying For Junior Member

Norman Beryl Brasel, Kansas City, Mo.
Delmar E. Calhoun, Durango, Colo.
Lincoln Mun Hoy Chang, Biloxi, Miss.
Junn-Ling Chao, Minneapolis, Minn.
Jack Gordon Conway, Cincinnati, Ohio.
Herbert Leo Crane, Detroit, Mich.
Wilfredo Crespo Perez, Mexico, D. F., Mexico.
Sandor Csallany, Urbana, Ill.
Henry Albert Rawdon De Paiva, Urbana, Ill.
Kamal Noori Fattah, Baghdad, Iraq.
Pablo Girault, W. Lafayette, Ind.
Gerald M. Hansler, Portland, Ore.
Lewis John Harthan III, Los Angeles, Calif.
Jonathan Otto Maximiliaan Frederik Hoeke, Baghdad, Iraq.
Dinker Pranlal Joshi, Boston, Mass.
Thomas Roland Koval, Cheverly, Md.
Wei-Jen Lin, Minneapolis, Minn.
William Malcolm McNaughton, Reno Route Cougar, Wash.
Thomas McNeill Memory, Pittsburgh, Pa.
Jarvis Dale Michie, Baton Rouge, La.
S. Nagaratnam, Chicago, Ill.
Frank Martin Naglich, Detroit, Mich.
Koneerupatti Ramaseshan Narayanaswamy, Bhilai, India.
Gabriel Andrew Pall, Philadelphia, Pa.
Jaroslav Frank Polma, Pittsburgh, Pa.
B. Naga Raju, Dearborn, Mich.
Walter Francis Rowland, Decatur, Ill.
Ravinder Kumar Sahgal, Champaign, Ill.
Joseph Schneider, Jr., Wilmington, Del.
Edward Joseph Seitz, Cincinnati, Ohio.
Antonio Xerxes Sison, Manila, Philippines.
Henry Fisher Thomas, Jr., Bedford, Mass.
Nalin Kumar Harilal Udani, Toledo, Ohio.
Jarrette Andrew White, Smyrna, Ga.

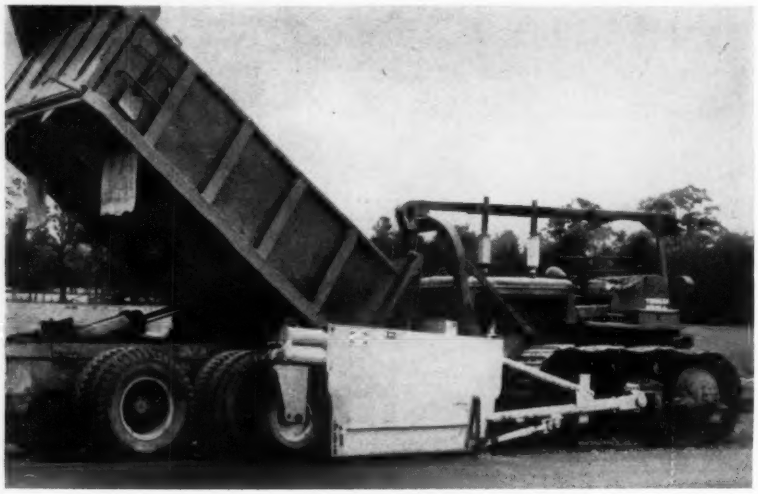
[*Applications for Junior Membership from ASCE Student Chapters are not listed.*]

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Base Paver Attachment

A NEW BASE PAVER ATTACHMENT, designed for standard crawler-type tractors with sufficient power for its operation, is now being marketed. The attachment, Model P-160, features: an exclusive oscillating screed that promotes accurate depth and level control, quick crown adjustment, and eliminates voiding and segregation; and a mounting hitch custom-built for a specific tractor. The attachment will spread stone, slag, gravel, soil, and pug mix aggregates up to 400-tons per hour. Manual screw type controls can be set to spread from 1 to 20-in. deep. The machine's normal 10-ft, 10-in. width can be blocked off to 7-ft, 2-in. Adjustable hinged hopper wings permit a maximum spreading width of 16-ft. **Blaw-Knox Company, CE-5, 300 Sixth Ave., Pittsburgh, Pa.**



Easy Depth Adjustment

Computer Applications Laboratory

ORGANIZED TO PROVIDE A COMPLETE RANGE of analytical and computational services, the Computer Applications Laboratory is prepared to provide an effective and economical approach to the solution of an entire problem—regardless of size. The staff includes recognized leaders in the fields of mathematics and electronic data processing, plus a group of more than 70 capable specialists representing a broad spectrum of scientific commercial and military activity. The Computer Center is equipped with an IBM 704 Computer. The high-speed, random access, magnetic-core memory has a storage capacity of 8192 words. In May, 1958, this capacity will be increased to 32,768 words. Magnetic drums provide an equal amount of direct-access storage, and ten magnetic-tape units furnish almost unlimited data-handling capability. **General Electric Computer Dept., General Electric Co., CE-5, Phoenix, Ariz.**

Digital Computer

SOME OF THE PRINCIPAL FEATURES of the G-15 Computer are: it combines the advantages of a general purpose computer and a digital differential analyzer in one machine; it has paper tape punch and high speed reader as standard equipment; and it has versatile, easy to learn programming methods. With just 4 hours of instruction, personnel who have had no computer experience can now solve their own problems with the G-15. Since it is so low in cost, many companies are finding it profitable to put their computers right in the office or laboratory. There they can be used directly by the personnel who know the problems best. The inefficiency of waiting for "computer center" solutions is eliminated. The Intercom programming system makes this ease-of-use possible. In this system, a single command results in a number of internal operations. Since Intercom is floating point, the user does not need to consider scaling problems. Without changing commands, it will operate with either a 5 or a 12 decimal digit word, plus 2 digit decimal exponent. Positive or negative numbers may be used. **Bendix Computer Div., Bendix Aviation Corp., CE-5, 5630 Arbor Vitae St., Los Angeles 45, Calif.**

Hammer-In Fastening Tool

A TIME SAVING OF 35% was made in anchoring underfloor raceways to concrete flooring in the world's first all-bronze building, the Seagram Building, Park Avenue, New York City by using Shure-Set, a hammer-in fastening tool. It is reported by Fischbach and Moore, one of the world's largest electrical contractors, that workmen, using the tool, could put down 30 lengths of fibreduct to every 20 that were being put down by other methods. Workmen liked this tool because it was simple to operate, the contractor stated. Shure-Set is a fastening tool so designed that a workingman, swinging a hammer can drive a stud into concrete or steel a quarter-inch thick. **Olin Mathieson Chemical Corp., CE-5, 460 Park Avenue, New York 22, N. Y.**

"Vari-Pitch" Sheave

A NEW COMPACT "S" SECTION "Vari-Pitch" sheave which permits wider speed changes and increased horsepower transmitting capacity has been announced. It has a range of 5.5-in. minimum to 120-in. maximum and it complements the present wide range "Q" and "R" section "Vari-Pitch" and companion sheave line. Companion sheaves with "Magic-Grip" bushings in sizes from 8.0 to 24.0-in. pitch diameter are available along with "S" section belts in lengths from 54 to 150-in. The "S" section belt has a maximum width of 2$\frac{1}{16}$-in. which is wider than "Q" or "R" section units. **Allis-Chalmers Manufacturing Co., CE-5, Milwaukee, Wisconsin.**

Power Bench Type Punch Press

A COMPLETELY NEW MODEL B-3 3-ton Power Bench Type Punch Press is now available. This press can easily be adapted for any standard punching operations within rated capacity. It can punch, shear, form, blank, cut, draw, etc., materials such as metal, leather fiber textile, plastics, paper, etc. Most makes of small presses are available only in 2-ton, 4 or 5-ton capacities. The Model B-3 will enable companies with operations requiring 3-ton capacity to purchase this press at much less investment than previously required for a 4 or 5-ton model. **Alva Allen Industries, CE-5, 1001-15 N. 3rd St., Clinton, Mo.**

EQUIPMENT MATERIALS and METHODS

(continued)

Liquid Flow Recorder

ACCURATE LOW-COST GRAPHIC AND visual registration of liquid flow is provided for sewage treatment plants and other installations with the Stevens Recorder, Type B-FT. This recording, indicating and totalizing meter measures liquid flow over Parshall flumes and weirs. The recorder features interchangeable flow cams and flow conversion gears. This is an important economic factor to sewage treatment plants in rapidly growing communities, and in

B-FT

other installations where liquid flow may increase substantially beyond originally anticipated limits. With a simple change of cams and gears, the recorder can operate with a different size flume or accommodate a greater range of flow than that for which it was originally purchased. The change does not require factory service. Similarly, change from weekly to daily graphic time scale, or vice versa, is accomplished by merely repositioning one gear. **Leupold & Stevens Instruments, Inc., CE-5, 445 NE Flisan St., Portland 13, Ore.**

Steam Cleaner

A NEW HEAVY-DUTY STEAM cleaner, designated the 280 "Blast-Master," has been announced. According to the manufacturer, it is the world's most versatile steam cleaner, delivering all or any part of a full 280-gal per hour of balanced cleaning solution. This new model is designed specifically for fleet operators, heavy equipment distributors and contractors. **Clayton Manufacturing Co., CE-5, 401 N. Temple City Blvd., El Monte, Calif.**

EQUIPMENT MATERIALS and METHODS

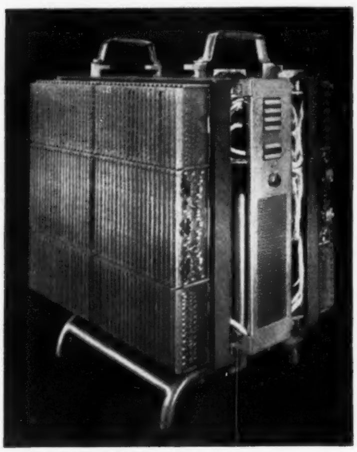
(continued)

All-Aluminum Supports

For the first time, supports are available in high-strength, light-weight, corrosion-resisting aluminum. These supports—from a simple top-mounting pedestal to a rugged 100-ft overhead span—are designed not as independent units, but as component parts of closely knit traffic control systems. The benefits of all-aluminum supports are obvious—easy erection and freedom from periodic maintenance. **Pfaff & Kendall, CE-5, 84 Foundry St., Newark 5, New Jersey.**

Midget Computer

Recomp, a transportable, midget computer that can add, subtract, multiply and divide 1,000 times faster than the familiar desk calculator, has been designed and developed. The first model of this general-purpose, all-transistor digital computer, designated CP-266, has been produced and delivered to the U.S. Air Force Rome Air Development Center. Recomp is small by comparison with computers of similar type and capacity. Nevertheless, its capability and reliability equals and exceeds that of many



Transportable

much larger machines. The compactness, ruggedness and mobility incorporated in its design makes it useful in solving all types of problems in the laboratory and office, as well as handling data and reducing problems in the field. The computer package only weighs about 200-lb and measures a mere six cubic feet. It can be lifted easily by two or three men and transported in a small vehicle. **Autonetics, Division of North American Aviation, Inc., CE-5, 9150 E. Imperial Highway, Downey, Calif.**

Portland Convention of ASCE
June 23-27, 1958

Room Reservation

Send to: Housing Committee, ASCE
824 S. W. Fifth Avenue
Portland 4, Oregon

Name ....
(*Please print*)
Address ....
City ....State..................
Please reserve for my occupancy the following hotel accommodations
Preferred price range $....................to $....................
Date arriving ....Hour...................... a.m. / p.m.
Date departing ....Hour...................... a.m. / p.m.

Daily Rates

Room for one	$5.50— 7.50
Double bed, room for two	7.00—14.00
Twin beds, room for two	9.00—16.00
A nominal additional charge will be made for more than two persons in one room.	
Deluxe room	13.00—16.00
Suite	about 25.00

Reservations Must Be Received

not later than June 9th and will be held only until 7 p.m. unless a later hour is specified. The convention will be held in the Multnomah Hotel. This hotel cannot accommodate the entire convention and registrants applying late will be housed in the Imperial, Benson, Congress or Heathman Hotels. Reservations will be confirmed by the hotel.

Combination Grader & Vibratory Compactor

The model 503 motor grader and a Jackson electric vibratory compactor are now being offered as a dual purpose unit for maintaining, leveling and compacting. Soils compaction is receiving more and more attention of highway engineers, with inspection and testing of the compaction job becoming more and more severe. It is a well-known fact that vibratory compactors will do a more efficient compacting job when they are working over even or smoothed surfaces. Thus, it is claimed this combination of grader and dynamic compactor will easily, speedily, and economically accomplish any specified density. It is emphasized by Galion that this unit offers the money-saving advantages of dual-purpose equipment. The combination grader-compactor is sold only as a complete unit. The 503 tandem drive gives added traction and smoother results similar to that obtained with a conventional four-wheel tandem drive over a two-wheel drive machine. The vibratory compactor consists essentially of the proper assembly and suspension of four 26-in. wide electric vibrating compactors. The compactor workhead is connected by drawbars to the head block of the grader. The grader is adequately protected against the vibration of the compactors. Raising and lowering the compactor is done by hydraulic control from the grader operator's platform, permitting high speed mobility on the job and between jobs. **The Galion Iron Works & Mfg. Co., CE-5, Galion, Ohio.**

Dual Purpose Unit

Area Calculator

An electrical instrument used for determining the number of square inches in given areas on maps, aerial photos, and drawings, has been made available. Calibration of the machine is in 100ths of a square inch. The number of square feet, acres, square miles, etc., in a specified area can be determined by use of conversion factors. Time is saved by the use of this rapid method of determining measurement of areas regardless of the scale. The case which contains the counter, transformer, and other electrical components, is constructed of sheet metal with a durable grey hammertone finish. It measures 6-in. wide by 6-in. deep by 7-in. overall height. **Martin-Kuykendall Co., CE-5, 1002 4th St., Albuquerque, New Mexico.**

EQUIPMENT MATERIALS and METHODS

(continued)

Improved Whiteprint Machine

THE MODIFIED AND IMPROVED Printmaster 810, a medium priced whiteprint machine for the reproduction of engineering and architectural drawings and a wide variety of business forms and other materials, has been introduced. The 810 accommodates materials of any length and up to 42-in. in width; its printing and developing speeds are synchronized to 40-ft per minute. The machine has been designed so that only modest floor space is required. Its extremely compact dimensions, 61-in. wide x 42-in. deep x 61-in. high, conserve valuable floor space. Low height of the 810 puts the front receiving tray below the eye level of the operator to make it easier to check print stacking and also to remove prints from the print receiving tray. This feature and the convenient placement of control knobs reduce operator fatigue. The front stacking tray will accept prints up to 24-in. long. An optional rear stacking tray handles prints up to 36-in. by 42-in. **Ozalid Div., General Aniline & Film Corp., CE-5, Johnson City, N. Y.**

Modified & Improved

Auto-Point Computer

A NEW COMPUTING INSTRUMENT CALLED the IBM 610, now simplifies the solving of such problems as heat transfer, stress analysis, matrix arithmetic, sales forecasting, and curve fitting. It is as easy to operate as it is to learn because of the automatic positioning of decimal points, mobile, desk-side convenience, multiple instructions via a single key, and identifying headings by manual typing. **International Business Machines Corp., CE-5, 590 Madison Ave., New York 22, N. Y.**

EQUIPMENT MATERIALS and METHODS

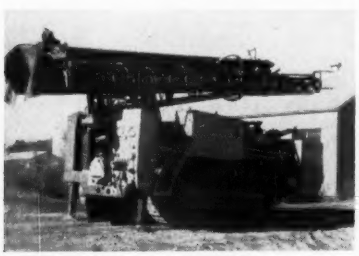
(continued)

Electronic Backup Horn

THE ADCO DYNALARM WAS designed to provide an automatic and effective warning signal for any type of vehicle when moving in the reverse direction. It is far more than merely a horn; it is a safety system, with its entire concept, design and manufacture engineered for complete reliability. Once installed, it becomes a permanent part of the vehicle, giving many years of uninterrupted, maintenance-free operation. Some of its features include: positive, automatic warning action; meets all safety specifications; directed sound; and positive, foolproof actuating switch. **Atkinson Dynamics Co., CE-5, 10 W. Orange St., South San Francisco, Calif.**

Rotary Drill

THIS NEW ROTARY DRILL USES a mechanical drive for rotating the drill bit and two Vane-type pumps to provide oil flow and pressure for the hydraulic cylinders. Power is taken from the front and rear power take-off on the crawler tractor. The crawler tractor transmits power from the rear power take-off to a Fuller Transmission with 5 speeds forward and reverse which turns a right angle drive. The right angle drive is connected to a square shaft extending the full length of the drill and operates a floating head or gear box. Proper gear ratios in the transmission, the right angle drive, and floating head make it possible to vary drill rotation speeds from 20 to 130-RPM. It is possible to vary down pressures up to 60,000-lb on the drill bit by the use of two 6¼-in. I.D. feel cylinders. Pressure and flow in the hydraulic system are obtained with two Denison Vane Pumps that operate off the front power take-off. Three leveling jacks and two breakover cylinders are also used in the hydraulic system. **Robbins Machine & Mfg. Co., CE-5, Highway 32 North, P.O. Box 281, Oneonta, Ala.**



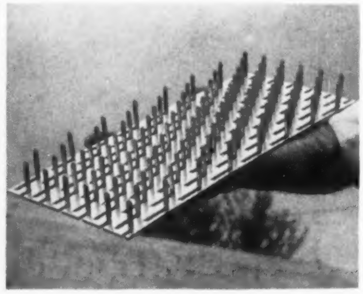
Mechanical Drive

EQUIPMENT MATERIALS and METHODS

(continued)

Gang Nail Trusses

A NEW ROOF FRAMING SYSTEM, the Gang Nail Truss, has been introduced. Developed to provide a sturdier yet far cheaper means of constructing roof frames, this new system centers around a "Gang Nail Truss," a connector plate for the wooden joints. These plates are made by bending nails $^{13}/_{16}$-in. in length out of galvanized 14 gage sheet steel. The connector plates are available in various shapes and sizes. By using the plates instead of a carpenter driving nails into the joints, the company claims there are substantial savings, up to $250 for the ordinary six room house. The Gang Nail Trusses have been approved by FHA and VA. According to the manufacturer, the trusses are exceptionally rigid in handling; they can be erected without loosening of plates; they eliminate foundations under interior partitions; and they practically eliminate plaster cracks in the ceilings. **Gang Nails Inc., CE-5, 8410 Bird Road, Miami, Fla.**



Substantial Savings

Tractor-Shovel

A NEW $2\frac{1}{4}$-CU YD Tractor-Shovel known as the Model 200, has been announced. This machine has been designed and built for extra heavy duty work with maximum speed and working efficiency. Some of its features are the following: Nelson underslung arms with 100% operator visibility and safety—at no time does any object such as cylinders, hoses, etc. protrude past the operator's cockpit; the bucket has 40-deg tipback at ground level; and the maximum dumping height is 9-ft 6-in.; forward reach of 5-ft 7-in. at dumping height of 7-ft.; an Allison Torqmatic full reversing transmission with a 3.5 to 1 stall ratio. **N. P. Nelson Iron Works, CE-5, 850 Bloomfield Ave., Clifton, New Jersey.**

Advance Information on Attendance at ASCE Portland Convention

Send to: Chairman H. Loren Thompson
Post Office Box 508
Portland 7, Oreg.

It is my plan to attend the Convention of ASCE. I plan to attend the following events of the Convention, for which I shall purchase tickets after arrival:

Function	No. of Tickets
Monday, June 23	
Barbeque	....
Luncheon	....
Tuesday, June 24	
Tours (specify which)	....
Pipeline Dinner	....
Wednesday, June 25	
Luncheon	....
Hydraulics Dinner	....
Thursday, June 26	
Luncheon	....
Dinner-Dance	....
Friday, June 27	
Luncheon	....
General Tour	....

To: Jackson L. Durkee
Bethlehem Steel Company
Fabricated Steel Construction
Bethlehem, Pa.

☐ I am interested in attending the Structural Division Conference on Electronic Computation. Topics of major interest to me are ....
....

☐ I am interested in submitting a paper for presentation at the Structural Division Conference. The subject is ....
....

☐ I am enclosing suggestions for topics and/or special lecturers.

Very truly yours,

....
NAME

....

....
ADDRESS

....
DATE

Electronic Computer

A QUARTER-MILLION-DOLLAR ELECTRONIC computer named "DAEAC" has arrived at Lockheed Aircraft's Marietta, Ga., plant and is being installed in the engineering electronic computer center. The purpose of the complex electronic equipment, called a "Direct Analogy Electric Anal-g Computer," is to analyze complex stress and flutter problems at the higher mach supersonic speeds at which tomorrow's aircraft will fly. The new computer—one of only a few in existence—can solve the problems faster and more economically than in conventional wind tunnel tests. The problems are fed to the machine as "electrical breadboard models" of wing flutter. Answers are received on oscillograph records. **Lockheed Aircraft Corp., Georgia Division, CE-5, Marietta, Georgia.**

Latex Paint

WATER-BASED LATEX PAINT FOR outdoor use is being tested on some 20 houses and buildings across the United States to determine the resistance of this paint to a variety of climatic conditions. This long-range test is believed one of the first of such wide scope ever undertaken on water-based paints for exterior use. Latex paints produced from Bakelite vinyl acetate resin WC-130 have already won spectacular popularity as indoor coatings. Now WC-130 makes possible competitively-priced outdoor paints offering important advantages over conventional paints for outdoor use. These paints based on WC-130 have excellent resistance to moisture. They are easy to apply with brush, spray or roller. They dry to a well-knit film within a few hours, so that second coats can be applied the same day as first coats. They are fire resistant, practically odorless, free from graininess, resist foaming and give a dense uniform film. The paints cover well and can be cleaned with soap and water. **Bakelite Co., Division of Union Carbide Corp., CE-5, 655 Madison Ave., New York, N. Y.**

Uniflow Settling Tank

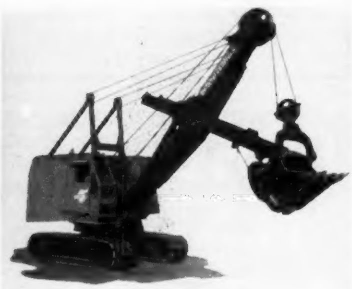
AN IMPROVED SETTLING TANK DESIGN, the Uniflow Settling Tank, for removal of solids from water, sewage and industrial wastes, has been announced. It combines a rapid sloping bottom with multiple effluent weirs. This advanced design increases efficiency of solids removal, offers economical construction, and as the name Uniflow implies, maintains the velocity of liquid throughout the tank at as nearly uniform a rate as practical tank construction allows. Link-Belt Straightline sludge collectors provide positive removal of scum from the surface of the liquid and sludge from the bottom of the tank. Experience shows that removal efficiency depends only on the overflow rate and not upon the depth of the basin. The surface area is not reduced even though the volume of the tank may be reduced as much as 50%. Consequently, the overflow rate is not altered. Test results show that for equal flow rates and with a detention period of about ¾ that of a conventional tank the efficiency of the Uniflow was practically the same as that of the conventional tank. **Link-Belt Co., CE-5, Prudential Plaza, Chicago 1, Ill.**

The Draftette

A NEW DESIGN PORTABLE drafting machine, so compact that it can be folded jackknife style to fit in the pocket when detached from its drawing board, has just been introduced for use in office, home, classroom, and workshop. The precision instrument, in its new design, is now available attached to a portable drawing board that fits easily into a briefcase. The unit takes the place of T-square, ruler, protractor and triangles. "Draftette" is of all aluminum construction, anodized jet black with gleaming white-filled numbers and letters of the scale and 180-deg protractor. Use of aluminum accents the lightness, long life and dimensional stability of the unit. **David Miller and Associates, CE-5, Box 572, Beverly Hills, Calif.**

3-Yd Shovel

THE 3-YD MODEL 3600 shovel has been added to the company's line of cranes and excavators. Basically a shovel, it is also convertible to crane, clamshell and dragline applications. The Model 3600 employs such ultra-modern components as the 3-stage torque converter coupled to a fast, rugged engine equipped with the "Torque Limiting Tail Shaft Governor." This combination allows the machine to take full advantage of the tremendous reserve of power available through torque conversion yet takes responsibility for restraint of torque wherever it could be harmful to the excavator. It contains just 14 gears in the entire machine with the gears turning only when working to reduce power loss. This is accomplished with the exclusive "Powerflow" slide pinion arrangement which directs power straight to the operating function including steering. Designed as a "working partner" with other machinery used on today's construction projects, the boom, sticks and



Fast, Rugged Engine

shipper shaft of the 3600 are so tough that there is no need to "baby" the front end and the dipper will not twist away or glance off exceptionally tough digging areas. The shipper shaft is positioned at an ideal location on the boom so that the machine can achieve working ranges tuned to modern construction practices and the size and shape of modern hauling units. **Manitowoc Engineering Corp., CE-5, Manitowoc, Wis.**

General Purpose Computer

THE LGP-30 ELECTRONIC COMPUTER is a general-purpose digital computer which fulfills the need for a small-sized reliable and low-priced scientific computing device. Its range of calculations and the scope of its applications is almost limitless. It has a relatively simple command structure, a magnetic drum memory which holds 4096 words, and the simplicity control panel which allows the operator to concentrate on his problem rather than on the operation of the machine. **Royal McBee Corp., CE-5, Westchester Ave., Port Chester, N. Y.**

New Water Pumps Designed For Industry Water Supply

THE MANUFACTURERS OF submersible pumps for water wells have added new high capacity 50-hp units to their line, thus extending the range of Sumo pumps from ⅓ to 50-hp. 8-in. models are available to deliver capacities to 420-gpm and total heads to as high as 600-ft. A completely new 10-in. line with pump dia of 9⅛-in. in 15, 30, and 50-hp sizes delivers up to 640-gpm. Of special interest to large volume users of water, they are particularly adaptable to commercial, general water service, air conditioning, and fire fighting. Pump construction utilizes stainless steel and bronze throughout. **Sumo Pumps, Inc., CE-5, 23 Brown House Road, Stamford, Conn.**

EQUIPMENT MATERIALS and METHODS

(continued)

Motorized Psychrometer

The battery powered motorized psychrometer, an instrument for recording relative humidity and dew point reading, can be used successfully in many fields such as: heating, air conditioning, food and chemical processing, and transportation. Some of its features include long life motor, 6 volt standard inexpensive battery, and steady aspiration over wet and dry bulb in excess of 20 F.P.S. **E. Vernon Hill & Co., CE-5, P.O. Box 189, Lake Geneva, Wisconsin.**

d/M Gauge

A recent development promises to become a standard tool in modern highway construction programs. The d/M Gauge is a completely portable new system, which gives accurate and immediate on-the-spot determinations of soil moisture content and density during soil compaction control tests. Thus for the first time in highway construction work it is possible to determine when the optimum degree of soil compaction has been attained—while the compaction equipment is still at the site of operation. Accurate and extensive studies of moisture-density data in such compaction control tests result in a greater stability and more uniform wearing characteristics in the completed highway. **Nuclear-Chicago Corp., CE-5, 229 W. Erie St., Chicago 10, Ill.**

Transac S-1000 Computer

The new transac s-1000 data processing system has been introduced to the business world. The computer has a 36 binary digit word length capacity with 4,096 word memory in excess of 45,000 alpha-numeric characters. It can execute more than 100,000 additions or subtractions per sec, with character recall from memory in 12 microseconds. The entire Transac S-1000, including memory control and power supply units is housed in a standard office-type desk console which occupies about 36-cu ft. It is ideally suited to installations in high rental, mid-city locations where space is at a premium. It can be rolled from place to place on integral casters. It requires no special site preparation. The computer plugs into conventional 110 volt, 60 cycle electrical outlets; it is designed to accommodate peripheral flexwriters, paper tape readers, tape punches and similar output devices. **Philco Corp., CE-5, Philadelphia 44, Pa.**

Literature Available

Record Abroad—Called "Fifty Years Abroad with Raymond," this 10-page booklet shows through photographs Raymond's record abroad. A few of the facts listed are: the Company's experience outside the United States dates continuously from early 1900; it has completed over 1475 contracts outside the United States; and the dollar volume of these contracts is over $1,400,000,000. Some of the examples of work done by this Company are: hospitals, process plants, dams, and derrick bases. **Raymond Concrete Pile Co., CE-5, 140 Cedar St., New York 6, N. Y.**

Bucket Drilling—"Methods Manual," a new 16-page booklet that illustrates and describes the advantages of bucket drilling as a method of excavating, has been published. Written especially for general contractors, excavators and drillers, it includes many on-the-job photos which show how earth drilling provides a fast, economical method of excavating for tank burial, foundations, manholes, cesspools, soil tests, mining and many other digging jobs. **Calweld, Inc., CE-5, 7222 E. Slauson Ave., Los Angeles 22, Calif.**

Pavement Maintenance—This 24-page booklet is published in the interest of highway safety. Designed for road maintenance men and other public officials responsible for safe winter pavements, this is a safe-roads fact book about a modern snow and ice removal program called Bare Pavement Maintenance. Some of the subjects discussed are safety, speed and savings, average braking distances (chart), bare and dry pavements, and spalling and corrosion. **International Salt Co., CE-5, Scranton, Pa.**

Air Compressors—Discussed in this 4-page pamphlet are the diesel-driven, portable, engine-compressors, which range in air capacity from 55 to 320-cu ft per min. They are unique in this country in that they are completely air cooled and require no liquid coolant whatever. Compressor and drive units are integral, working on the same motor block, on the same crankshaft, lubricated by the same system in a common crankcase. **Air Compressors, Inc., CE-5, 2339 W. Beaver St., P.O. Box 2976, Jacksonville, Fla.**

Vapor Compression Evaporators—How a vapor compression evaporator works is discussed in this 7-page, illustrated booklet. The vapor compression distillation units compress steam produced in the evaporator to a higher pressure and temperature and discharge it back into the system. In this way latent heat is continuously transferred and recovered at low operational cost. This process is the "heat pump" or "vapor compression" principle. **Cleaver-Brooks Co., CE-5, 326 E. Keefe Ave., Milwaukee 12, Wisconsin.**

Literature Available

PIPE COATING PLANT—An 8-page, four-color brochure is now available which describes company's facilities for cleaning, coating and wrapping pipe in all sizes from three-quarter inch through 12-in. in its new Atlanta plant. Drawings illustrate various stages in the wrapping process, and a description is given of the Holiday detection test and other controls which assure that pipe is evenly coated and completely protected. A sketch shows the company's 17-acre yard for storage of bare and coated pipe. **Southern Pipe Coating Co., CE-5, 795 Peachtree St., N.E., Atlanta 8, Georgia.**

VALVES-HYDRANTS—A 72-page catalog, just completed and now available, gives detailed, up-to-the-minute information on the gate valves, check valves and hydrants especially developed and produced for water works service. It virtually doubles the size of the brochure it replaces, due to inclusion of far more extensive information on available types, accessories, dimensions, applications, construction details, special features, testing and operating methods. **Darling Valve and Mfg. Co., CE-5, Williamsport, Penna.**

METAL GRATING HANDBOOK—The first all-inclusive technical publication in the metal grating industry has been published. It represents a complete product standardization in the metal grating industry. It is not manufacturers catalog but rather a technical guide prepared by the industry itself. It contains 32 pages of informative text, schematic drawings, tables, actual installation photographs and a complete glossary of terms and definitions used throughout the metal grating industry. When writing for this handbook, ask for AIA File No. 14-A-I, furnishing the name of your company and your position. **Metal Grating Institute, CE-5, One Gateway Center, Pittsburgh 22, Pa.**

RENTAL RATES—A 1957 Compilation of Rental Rates for Construction Equipment has been released. The rates set forth are national averages compiled from reports of individual companies throughout the United States. The survey was conducted among approximately 750 distributor member firms during the months of May and June, 1957. It is emphasized that this booklet is published for informational purposes only, and is not intended to suggest or to influence the rates or terms of rental of any item of equipment. It is priced at $5.00. **Associated Equipment Distributors, CE-5, 30 East Cedar Street, Chicago 11, Illinois.**

IN-SITU BEAM SUPPORT—A new system of beam support is illustrated in the recently published brochure. Efficiency and economy are featured on this practical form approach. **Luderjak Co., Inc., CE-5, Route 4, Box 618B, Olympia, Wash.**

From the MANUFACTURERS

AUTOMATIC WELDING MACHINE: The world's newest and most modern automatic welding machine for metal grating, which took more than one year to build, was unveiled by the Klemp Metal Grating Corp. . . . **SALES PROGRAM:** A 5-year global program for sales of new, four-way interlocking aluminum shingles and siding has been set up with the signing of contracts between Reynolds Aluminum Service Corp., a subsidiary of Reynolds Metals Co., and International Aluminum Corp. . . . **NEW AGREEMENT:** Sun Oil Co., Philadelphia, and The Fluor Corp., Ltd., Los Angeles, have announced an agreement under which Fluor will provide consulting engineering and related design and construction services to industry for Sun's methods of industrial waste water management including the newly-developed technique of biological oxidation in cooling tower systems . . . **RELOCATION:** The Cleveland, Ohio, district sales office of The Babcock & Wilcox Company's Boiler division has been moved to 1367 The Illuminating Bldg., 55 Public Square, Cleveland 13. The office was formerly located at 1515 National City Bank Bldg., Cleveland 14. . . . **APPOINTED DISTRIBUTOR:** L. B. Foster Co. has been appointed an official distributor for Dresser couplings. The company will maintain large stocks of couplings for sale to contractors, mines, utilities, municipalities, and industrial users . . . The Yale & Towne Manufacturing Co. has appointed two new distributors for its Trojan line of tractor shovels . . . **NEW OFFICE:** The Concrete Products Division of American-Marietta Co. announces the opening of a New York office at 50 Church St., New York City . . . **ASSUMES OPERATIONAL DIRECTION:** United Concrete Pipe Corp. has assumed operational direction of Rockwin Prestressed Concrete Corp. Operations will continue under the Rockwin name, producing precast prestressed concrete structural and building members . . . **SALE OF PIPE:** Keasbey & Mattison Co., Ambler, Pa., announces the sale of asbestos-cement irrigation pipe throughout the United States with shipment made from all of K&M's pipe plants . . . **NEW DIVISION:** The formation of a Concrete Pipe Division was announced by Vulcan Materials Co. of Birmingham . . . **APPOINTMENTS:** At the Annual Meeting of Stockholders of Lock Joint Pipe Co., Hugh F. Kennison was elected a Director of the Company . . . Harold A. O'Callaghan, President of Spanall of the Americas, Inc., has been elected to the board of directors of the Browne Window Manufacturing Co., Inc. of Dallas, designers and fabricators of custom-built windows and related architectural parts . . . Ansul Chemical Co., Marinette, Wis., has appointed James B. Reed as Manager of Detroit Operations.

PROCEEDINGS AVAILABLE

For instructions and key to abbreviations, see next page. Each member is entitled to 100 different "Proceedings Papers" yearly, ordered from these pages, plus all papers of the Technical Divisions in which he registers. The latter papers will be mailed automatically. Discussion of a paper will be receievd during the four full months following the month of issue.

April, 1958

1580. Dynamic Analysis and Response of Aircraft Arresting Systems, by Robert S. Ayre and Joel I. Abrams. (EM) An analysis of aircraft arresting systems, as lumped parameter systems omitting the effect of wave travel in the cable is presented. Comparison with small-scale experimental results, and response spectra of maximum cable tension under a wide range of operating conditions are included.

1581. On Inelastic Buckling in Steel, by Geerhard Haaijer and Bruno Thurlimann. (EM) A theoretical and experimental study on inelastic buckling of steel columns and plates is presented, including results of tests on model columns, angles and wide-flange beams. Recommendations are given for required geometric proportions of wide-flange shapes in plastic design.

1582. Eisenhower and Grass River Lock Models, by Martin E. Nelson and Harvey J. Johnson. (HY) The lock models described in this paper simulated, to a scale of 1 to 24.24, (model to prototype), upper and lower approach channels and lock chambers. The hydraulic systems consist of intake ports in the upper gate sill, culverts and ports in the chamber walls, and lateral culvert diffusers in the lower approach.

1583. Thermal Density Underflow Diversion, Kingston Steam Plant, by Rex A. Elder and Gale B. Dougherty. (HY) The solution to the diversion of cold thermally stratified density underflows up a side river channel and through a canal whose bottom is higher than the channel is presented.

1584. Submerged Sluice Control of Stratified Flow, by Donald R. F. Harleman, Robert S. Gooch, and Arthur T. Ippen. (HY) Results are presented of experimental and analytical studies on the selective withdrawal of water from reservoirs or rivers in which density stratifications due to thermal or other effects occur.

1585. Mechanical Analogs Aid Graphical Flood Routing, by Max A. Kohler. (HY) Graphical techniques for routing directly on the plotted hydrograph charts are described, and mechanical analogs facilitating graphical solutions are examined. An analog has been constructed which will accommodate the use of graphical relations for inflow versus lag, and storage versus outflow.

1586. Tidal Movement in the Cape Cod Canal, Massachusetts, by B. W. Wilcox. (HY) Variations in the form of the tide wave at selected points, analyses of observations to obtain harmonic constants, and a method for predicting tidal currents in the canal are presented. Diagrams show the shapes of the tide curve.

1587. Distribution of Sediment in Large Reservoirs, by Whitney M. Borland and Carl R. Miller. (HY) The factors affecting the sediment distribution in a reservoir are examined and two methods are presented by which the probable distribution can be predicted.

1588. Water Distribution Design and The McIlroy Network Analyzer, by M. B. McPherson and J. V. Radziul. (HY) The paper illustrates time-distribution of demand rates, design rates and equalizing storage requirements for certain Philadelphia districts. Efficacy of perfectly-balanced system characteristics and utilization of the McIlroy Analyzer for design in Philadelphia are described. Merits of different types of computers are compared.

1589. USBR's Lower-Cost Canal Lining Program, by R. J. Willson. (IR) This paper describes the growing problem of water deficiency in the west and examines several methods of lining waterways to alleviate water loss. Advantages and disadvantages of each method are cited.

1590. Water Yields as Influenced by Watershed Management, by Robert H. Burgy. (IR) Studies show that appreciable increases in runoff result from replacement of brush by grass. Factors in precipitation disposal relating to influence of watershed vegetation on runoff are examined.

1591. Irrigation in New Jersey, by Robert L. Hardman. (IR) This paper describes the recent rapid growth of irrigation, and examines available water, and experimental studies. The need for protective legislation to control consumptive use of water in humid states is commented on.

1592. Water Intakes in the Detroit River, by Eugene A. Hardin. (SA) A new water supply system will serve the communities of the southeastern part of Wayne County, Michigan. Features are a water intake in the Detroit River and a raw water tunnel extending inland to a pumping station and purification plant. Other intakes of the Detroit River are also examined.

1593. Highway and Bridge Surveys: Reconnaissance, Progress Report of the Committee on Highway and Bridge Surveys. (SU) The importance of good reconnaissance in the selection of new highway routes is underscored. The conduct of reconnaissance is described and essential elements of the reconnaissance report are enumerated.

1594. Geodetic Control for Tropospheric Scatter Antennas, by Max O. Laird and Antonio Aguilar. (SU) This paper examines second and third-order triangulation expansions controlling the aiming of highly directive antennas, boundary, topographic and construction surveys, at radio stations providing public telephones and network television services between the United States and Cuba.

1595. Short Methods in Adjustment of Observations, by M. V. Smirnoff and Paul E. Wylie. (SU) Adjustment of observations in one and two variables which must conform to a straight line, natural or logarithmic are considered. Formulas for the adjustment by the method of least squares are presented as a possible substitute for the formal application of the method.

1596. Effect of Deflection on Lateral Buckling Strength, by J. W. Clark and A. H. Knoll. (EM) The effect on lateral buckling strength of the deflection or curvature that occurs in an initially straight beam or beam-column prior to buckling is investigated. An analytical study of beams and an experimental investigation of beam-columns are presented.

1597. Pore Pressure in Concrete Dams, by Chong-Hung Zee. (PO) This paper analyzes pore pressure in concrete dams. The mechanics of uplift force acting within a concrete body by conceiving the concrete as a space frame structural body are examined.

1598. Ambuklao Underground Power Station, by Andrew Eberhardt. (PO) Power features of the Ambuklao Project in the Philippines are described. An underground power station was constructed at a site which offered complex rock conditions. A feature of this power station is the horizontal shaft setting of the generating units.

1599. Insurance Aspects of Nuclear Energy, by Edward K. Lloyd. (PO) The paper presents an insight into nuclear energy insurance. Syndicates or insurance pools formed to write insurance on nuclear facilities are described in detail. Insurance rates for nuclear risks and amounts of insurance available to industry are explained.

ORDER FORM FOR PROCEEDINGS

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American Society of Civil Engineers
33 W. 39th St., New York 18, N. Y.

Please send me the PROCEEDINGS PAPERS which I have circled below.

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If more than one copy of a paper is desired *(for which a charge of 25¢ per copy will be levied)* indicate here: ....

Please send me *(at a cost of $1.50 EACH)* the circled DIVISION JOURNALS:

April: Engineering Mechanics, Hydraulics, Irrigation and Drainage, Sanitary, Surveying and Mapping, Power, City Planning.

Name *(please print)* .... Membership Grade ....

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1600. Civil Engineering Aspects of the Dresden Nuclear Power Station, by Joseph E. Love, Chester S. Darrow, and Burr H. Randolph. (PO) Design considerations arising from the layout of nuclear power equipment within a vaportight sphere are examined. Problems of more conventional nature are related to nuclear power plant design.

1601. The Spherical Containment Shell of the Dresden Station, by L. P. Zick, J. T. Dunn, and J. B. Maher. (PO) Problems encountered in the fabrication and erection of a spherical pressure vessel are presented. Special features are a containment housing around a nuclear power plant including a dual support system, access locks and unusual shell penetrations.

1602. Civil Engineering Aspects of the Fermi Atomic Power Station, by Pharo C. Burg and John G. Feldes. (PO) This paper describes processes employed in converting atomic energy into electricity at the Enrico Fermi Atomic Power Station. Arrangement of equipment and design considerations are examined, showing effect and relation to site development and structures housing principal equipment.

1603. Densities and Compaction Rates of Deposited Sediment, by Victor A. Koelzer and Joe M. Lara. (HY) This paper presents a review of important work concerning density and consolidation of deposited sediment as related to reservoir deposits. Attention is given to work in soil mechanics that has application in sediment consolidation.

1604. Incremental Compression Test for Cement Research, by A. Hrennikoff. (EM) This paper describes a compression test of cement and concrete that separates immediate deformation from creep. This determines elastic and inelastic characteristics describing the stress-strain properties of material and the internal mechanics of deformation and failure under load.

1605. Discussion of Proceedings Paper 1306. (SU) J C Carpenter on 1306.

1606. A National Water Quality Basic Data Program, by Ralph C. Palange and Stephen Megregian. (SA) This paper presents the Public Health program for collection of data on water quality, providing chemical, biological, and radiological analyses of the nation's water resources on a long-term basis.

1607. Water Intakes in the Niagara River and Lake Ontario, by Raymond H. N. Murray. (SA) This paper examines design conditions of the intakes for the towns of Tonawanda and Oswego, New York, and covers the intake cribs and lines.

1608. Digital Computers for Pipeline Network Analysis, by Quintin B. Graves and Don Branscome. (SA) This paper on digital computers for the solution of pipeline network problems sets forth one of the recent developments which should provide added economy in engineering design.

1609. Maintenance of Fine Bubble Diffusion, by Philip F. Morgan. (SA) Diffuser media for air diffusion may be clogged externally by a number of specific materials, and internally by particulate matter in the air supply. Procedures to control external clogging and a new air quality standard to eliminate internal clogging are presented.

1610. SED Research Report No. 16: Refuse Composting Experience in the Netherlands. (SA) Results of the Netherlands pioneering work in large scale municipal refuse composting through a government financed agency are reviewed.

1611. SED Research Report No. 17: Color Removal from Azo Dye Wastes. (SA) The efficiencies of treating ten azo dyes with stannous chloride for color removal have been determined. Color may be removed by heating the dye waste in the presence of stannous chloride, a powerful reducing agent.

1612. Advances in Secondary Processes of Sewage Treatments in the Period, October 1, 1954 to June 1, 1957. Report by the Sub-Committee—Section III of the Committee on Sewerage and Sewage Treatment. (SA) This paper examines secondary processes such as activated sludge, trickling filters and stabilization ponds. Factors of design and operation are reviewed and statements on radioactive and detergent materials are cited.

1613. A Study of Sewage Collection and Disposal in Fringe Areas: Progress Report of the Committee on Public Health Activities of the Sanitary Engineering Division. (SA) The accelerated growth of the urban fringe around American cities during the last three decades has created problems in providing community facilities. Providing these services is a challenge to professional groups and the public.

1614. Discussion of Proceedings Paper 928, 1408, 1411, 1461. (SA) Edwin A. Wells, Jr., and Harold B. Gotaas closure to 928. D. I. H. Barr on 1408. P. R. Krige, G. H. Teletzke on 1411. John S. Wiley closure to 1411. John W. Cunningham on 1461.

1615. Discussion of Proceedings Paper 1236, 1352, 1359, 1360, 1362, 1499, 1507. (IR) H. W. Adams closure to 1236. Harry F. Blaney on 1352. Robert O. Thomas on 1359. R. G. Cox, Steponas Kolupaila and John F. Kennedy on 1360. O. Starosolszky, Steponas Kolupaila, Armando Balloffet on 1362. Robert O. Thomas on 1499. Robert O. Thomas in 1507.

1616. Discussion of Proceedings Paper 1199, 1200, 1331, 1393, 1395, 1401, 1402, 1403, 1405, 1401-1406, 1401 and 1405, 1406, 1453. (HY) R. L. Wiegel, K. H. Beebe, and James Moon closure to 1199. Benjamin A. Whisler and Charles J. Smith closure to 1200. Vito A. Vanoni, Hsin-Kuan Liu on 1331. Theodor S. Strelkoff on 1393. G. N. Alexander, Max A. Kohler, Ralph W. Powell on 1395. E. A. Elevatorski, A. Rylands Thomas on 1401. A. Rylands Thomas on 1402. A. Rylands Thomas on 1403. A. Rylands Thomas, Earl J. Beck on 1405. W. H. R. Nimmo, Walter Rand on 1401-1406. Solano Vega-Vischi on 1401 and 1405. John R. Argue on 1406. Turgut Sarpkaya on 1453.

1617. The Geodimeter and Tellurometer, by Austin C. Poling. (SU) These electronic distance measuring instruments are examined relative to basic electronic principles. Methods of field operation are given. Line measurements with the geodimeter are compared with those obtained by other methods and accuracies are described.

1618. Discussion of Proceedings Paper 1397, 1398, 1414, 1420, 1488. (PO) F. L. Lawton on 1397. F. L. Lawton on 1398. M. H. Benson on 1414. Joseph R. Bowman on 1420. Clifton W. Bolieau on 1488.

1619. Discussion of Proceedings Paper 1141, 1196, 1290, 1390, 1495. (EM) Joseph Penzien closure to 1141. W. Nachbar closure to 1196. Kurt H. Gerstle closure to 1290. Zdenek Sobotka on 1390. Douglas T. Wright on 1495.

1620. Some Aspects of Urban Planning, by Sergei N. Grimm. (CP) This paper analyzes the urban planning concept, land use planning and its relation to transportation, planning of industrial and residential areas and community facilities, and coordinated use of regulatory and other devices for the guidance of land development.

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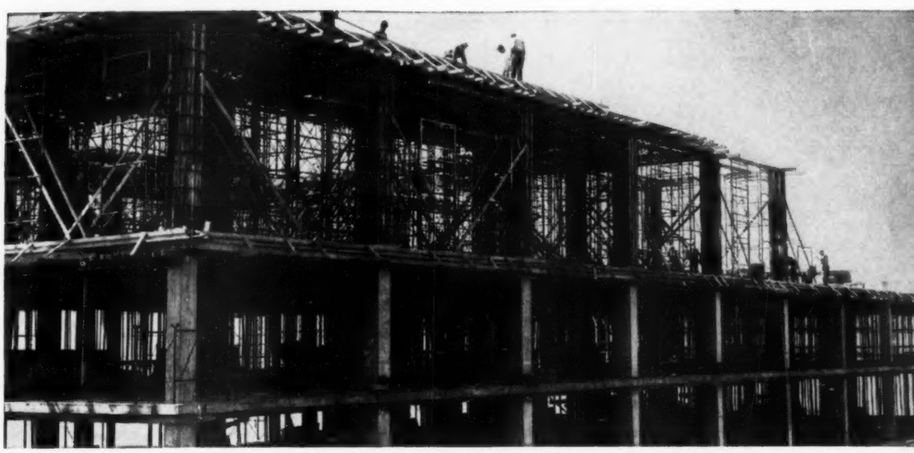

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